A Framework for the Effective Management of Collaborative R&D Projects

Executive Summary

A submission to the Engineering Doctorate portfolio of

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Abstract

There is a growing trend toward collaboration, both between companies, and between academia and industry. Studies have linked the use of external sources of information and expertise to the enhanced generation of innovation. Innovative companies, in turn, have been shown to out-perform non-innovating companies in terms of both growth and profit. Therefore, against a background of increasing international competition and rapid technological change, governments are actively encouraging collaboration as a means of improving innovation efficiency and thereby enhancing wealth creation. Collaboration provides companies with the means by which to advance technologically, at lower cost and with less inherent risk. Collaboration also provides access to a greater breadth and depth of knowledge and technologies than would normally be possible through internal development. For universities the benefits include additional public and private funding, and increasingly, licensing and patenting income, as a result of technology transfer activities.

However, these considerable potential benefits are often not realised in practice. The major reason is that collaborations between, often diverse, organisations, need considerable management effort in order to be successful. To this end, considerable research (reported in the literature) has been devoted to identifying management "success" factors, factors which where present, enhance the probability that a collaboration will be successful. This information was used by the author to develop a best practice model for collaboration management that is more comprehensive than has previously been reported in the literature. To date however, the literature provides no guidance as to how the full range of these success factors could be applied in the every day context of managing a collaboration.

The Framework presented here provides a mechanism for achieving more effective collaboration management in the form of a simple-to-apply management tool. The Framework was developed on the basis of case study research and disparate sources of relevant published research. Essentially, it provides a means of applying the current body of knowledge in a way that does not assume prior experience of collaboration management on the part of the user. Through the provision of reference material and diagnostic features, the Framework encourages an awareness of the key issues affecting the success of collaborations and prompts the manager to take appropriate and timely action to prevent the occurrence of problems later on. The main feature of the Framework's feedback mechanism, the Collaboration Chart, enables the user to identify quickly, specific areas where problems could arise. The concept of the Framework is new to the collaboration field and as such it constitutes the main innovation to result from this research.

Furthermore, while the Framework was originally conceived as a specific aid to collaboration between WMG and its industrial partners, this research indicates that it is potentially much more widely applicable. The Framework is certainly shown to be applicable to other university-industry collaborations, and with some modification, could also be applied to industry-industry collaborations. In addition, the Framework would lend itself to development into an evaluation tool that funding bodies could use to assess research proposals. The potential value of the Framework therefore extends beyond industry and academia, to ensuring the efficient use of public funds.

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Finally, thank you to my husband Stuart, without whom I could not have come this far.

Declaration

All work submitted to this portfolio unless otherwise stated, i.e. by reference to research published in the literature or private communications, is solely the work of the author.

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1. Introduction

1.1 The Background to Collaboration

1.1.1 Defining Collaboration

Collaboration is simply defined by the Centre for Exploitation of Science and Technology (CEST) [1] as "the activity of two or more partners working together to mutual benefit". However, Dodgson's [2] description differentiates collaboration from a business transaction: "Collaboration.....is based on the premise that through formal agreements, technology sharing between firms produces benefits that cannot be obtained by individual firms or through market transactions such as direct purchase, licensing or merger and acquisition." For the purposes of this research, the activities referred to by the term "collaboration" are more accurately described by the latter definition.

Collaboration can involve industrial partners only, i.e., industry-industry collaborations, or they can involve universities or other academic institutions, i.e. academic-industry collaborations. While this work uses relevant research findings associated with industry-industry collaborations, the focus of this research is on academic-industry collaborations, or more specifically, *university*-industry collaborations.

1.1.2 Incentives to Collaborate

A number of studies in recent years have found that there is an increasing trend toward collaboration between academia and industry and between firms [1, 3-5]. There are a number of reasons for this which vary according to perspective. At a national level the primary motivator is innovation. External sources of information and expertise have

been shown to enhance the generation of innovation. Furthermore, the work of Geroski & Machin [6] provided strong evidence to suggest that innovating firms consistently out-perform non-innovating firms in terms of growth and profit. Against a background of increasing international competition and rapid technological change, governments are therefore actively encouraging collaboration between firms and between the public sector science base (PSSB) and industry, as a means of improving innovation efficiency and thereby enhancing wealth creation [7, 8].

From an industrial perspective, rapid changes in the competitive and technological environments of a wide range of industries have resulted in a considerable degree of uncertainty with which companies must find a way of coping [9]. Collaboration allows companies to observe new technological developments without having to undertake the expense and risk of investing in speculative research [2].

It is stated that many new technologies develop from the integration of previously discrete areas of knowledge. However, the breadth of knowledge involved in such convergence of technologies is typically beyond the capabilities of all but a few firms and research organisations [2, 10]. Collaboration provides a company with access to a greater breadth and depth of knowledge and technologies, beyond what would normally be possible through internal development [2, 11]. It is also possible for partners to learn from each other in a shorter time than it would take to develop a particular skill or tacit technology internally [3].

Nueno & Oosterveld's [12] study of technological alliances found that the reduction in the costs of access to a technological capability was a primary motivator behind many firm's decision to engage in collaboration. Further, one third of the cases studied revealed that the companies would not have entered the alliance if the project to be undertaken had not attracted some form of external financial support [13].

While the above benefits and incentives are equally relevant to industry-industry and university-industry collaborations, Gregory [13] concentrates on the specific benefits that can accrue from collaborations involving universities. For example, the opportunity to observe and work with graduate students on a project can provide an effective mechanism for recruitment [13-16]. From the academic perspective, this is just one of a number of motivations which are driving the increasing number of academic-industry collaborations. Packham & Tasker [17] for example, drawing on their experiences of university-industry collaborations in the UK and the US, suggest that the advantages of industrial collaboration for a university include:

- The stimulus of different problems and different perspectives,
- Access to otherwise inaccessible research environments, e.g. industrial plant, schools, hospitals and government departments,
- Resources (including cash).

In their study of Eureka projects, Barker *et al* [15] found that access to complementary technical expertise was the primary motivation of both industrial and non-industrial (universities and research institutes) partners. EPSRC (Engineering and Physical Sciences Research Council) [18] list a number of other benefits with regard to universities:

- The opportunity to sustain existing research programmes and initiate new programmes by widening the customer base.

- The opportunity to learn new skills, developed within companies.

- Gaining an employer's perspective on the direction and content of teaching programmes; sourcing ideas for student projects and locating placement opportunities.

- Gaining the "inside track" on possible job opportunities for graduates, post-graduates, post-doctoral researchers and academics.

The benefits listed by Gregory [13] follow a similar theme in that it is suggested that, access to "real world" problems and the opportunity to become more familiar with industrial culture and technology needs, will enable a university faculty to become more effective educators and researchers.

Finally, there are financial advantages to collaboration from an academic perspective. Changes in economic circumstances in the US over recent years have meant that the government's ability to continue funding academic research to the same extent as in the past is increasingly unlikely [13]. Similarly, in the UK Shattock [19] has predicted that government funding will at best not improve and at worst will diminish as universities ultimately lose out against the "big spending battalions of health, social security, law and order, defence and schools". To this end, Shattock saw partnership with industry as not merely an opportunity to supplement research funds, but as essential to the survival of universities into the next century.

Greater collaboration with industry has certainly become a reality of academic life and in the UK alone, it is becoming a prominent feature in the life of universities such as Oxford [20], Cambridge [21], Cranfield [22], Edinburgh [10], Imperial College [4], Heriot-Watt [22], Queen's University, Belfast [22], Warwick [23] and Swansea [22]. Apart from the public and private funding that collaboration with industry can bring into a university, Shohet & Prevezer [4] show that universities are also increasingly benefiting from technology transfer activities in the form of licensing and patenting income.

1.1.3 Disincentives to Collaborate

The emphasis currently being placed on industry-industry and university-industry collaboration from the national, industrial and academic perspectives, is clearly being driven by the considerable potential benefits identified above. However, despite the trend toward increased collaborative activity, there is some evidence to suggest that these potential benefits are often not realised in practice.

One reason put forward for this is that the very nature of collaboration between often diverse organisations gives rise to substantial management problems. Dodgson [2] makes explicit the point that collaborations need considerable management effort to make them work. In the case of the Alvey programme in the UK, Dodgson [2] states that despite some technological successes, little commercial advantage has since been realised by the participating companies. Similarly, Barker *et al* [15] indicated that experiences among Alvey's participants had been mixed with almost one-quarter of participants reporting negative effects from unsuccessful partnerships.

Furthermore, a report on Alvey commissioned by the DTI and the Science and Engineering Research Council (now EPSRC) [24], revealed some significant difficulties relating directly to the collaborative nature of the programme. Among the points noted, there was a recognition that whilst most participants gained from the experience of collaboration, the high overhead costs of collaborating, in some cases, outweighed the associated benefits. Difficulties concerning exploitation were also identified.

Evidence in the literature indicates that collaboration in any form, can prove disappointing in terms of the expectations of collaborative partners. Spekman *et al* [3] suggest that the failure rate of strategic alliances is somewhere in excess of 60%. At the individual participant level, a report by CEST (Centre for Exploitation of Science and Technology) [1] draws attention to the findings of studies such as that by Harrigan [25], which found that among 895 joint ventures, only 45% were *mutually* agreed by their partners to be successful. However, placing this figure in context, the report [1] goes on to state that the success rate of acquisitions and mergers is even lower.

With respect to the realisation of benefits from collaboration, a study by Bruce *et al* [26] based on product development, found that collaboration can actually lengthen the process and add cost, as well as making the process more difficult to control. Such arguments directly contradict the alleged benefits of collaboration. The disincentives for collaboration identified by Bruce *et al* [26] can be summarised as follows:

- Prohibitive costs associated with the time and effort necessary to set-up and monitor the collaboration, and where required, to harmonise the different cultural styles of the parties involved

- A reduction in control over the product development process, with the prospective threat of a partner using the knowledge gained in a non-co-operative way

- The instability of such alliances as a result of a lack of trust. A fear of leakage of information, experience and skills essential to the core competencies of a firm, affect the successful function of partnerships, since successful collaboration depends on freely disclosed information

- Conflicts can arise as a result of divergent aims and objectives

It was evident from the above that despite considerable *potential* benefit, managing a collaboration successfully is difficult and therefore the *actual* benefits realised can be limited. Furthermore, while much of the above evidence arose from studies of industry-industry collaborations, differences in the priorities, perspectives and values of academia and industry (Section 2.1) indicate that the management problems associated with collaboration and the difficulties of ensuring that all partners achieve *actual* benefit, are considerably amplified in university-industry collaborations. Given the considerable investment in terms of time and resources that collaborative projects can involve, it is therefore important that an effective means of managing collaborations is established so that the benefits from them can be maximised.

1.2 Research Objectives

The above discussion has indicated that there is a growing world-wide trend toward collaboration between firms and between academia and industry, an activity which is also being actively encouraged by governments as a means of enhancing national competitiveness and wealth creation [7, 20, 27]. Warwick Manufacturing Group (WMG) is a part of this growing trend in so much as it is involved in collaborative research to a considerable degree, and is well known for its extensive links with industry. It was therefore, important to ensure that the management of WMG's collaborative research projects conforms to best practice. However, the main objective of this research was to extend beyond a simple evaluation of performance, toward the development of a management tool (based on best practice) which would provide a systematic, effective approach to the management of WMG's collaborative research projects and therefore enhance the probability of success.

Furthermore, given the inherent difficulties involved in managing all forms of collaborations successfully (reported in the literature), it was recognised that the resulting management tool could potentially be applied more widely, for example, to other university-industry collaborations. In order to establish if this was the case, the evaluation of WMG's collaborative projects was also used to determine the extent to which such projects, and any problems experienced within them, were typical of those reported in the literature. The objectives of this research are therefore summarised as follows:

Main Objective:

- To develop a management tool (a Framework) for the effective management of collaborative R&D projects that would enhance the probability of collaborations being successful

Subsidiary Objectives:

- To evaluate collaborative research projects in which WMG was an academic partner
- To establish, through comparison with best practice, how successfully these projects were managed
- To identify (also through comparison with best practice) areas where improvements could be made to the way in which these projects were managed
- To determine the extent to which WMG's projects, and any problems experienced within them, were typical of those reported in the literature

Given the substantial investment (both public and private) currently being made in collaborative research activities, the potential value of a management tool which will help industry and academia to manage collaborations effectively, thereby maximising the benefit achieved, is considerable. Examination of the published research provided no evidence to suggest that a Framework of this kind has been developed elsewhere in the context of collaboration management. The Framework is therefore the main innovation to result from this research.

1.3 Research Approach

For the purposes of this research, best practice with respect to collaboration management, was established through a review of the literature and interviews with experienced collaboration practitioners. The findings were used to develop a best practice model against which WMG could be compared. Detailed information regarding the management of WMG's collaborative research projects was obtained through case study research (described in Section 3). A comparison was then made between the best practice model and each individual project (case), in order to identify areas in which best practice was being demonstrated and areas where it was not. Analysis across the projects case studied was then used to identify patterns of similar findings and common factors.

The results of this case study research, along with relevant published research then formed the basis for the development of a framework for the effective management of collaborative R&D projects, the main innovation to result from this research. The framework was subsequently tested through trial implementation in a current collaborative project.

1.4 A Guide to the Portfolio Submissions

The purpose of this section is to provide a brief overview of the individual reports submitted to this portfolio, highlighting the issues addressed in each report, the research methods employed and the major outcomes and achievements (Table 1). This section also includes a "route-map" (Figure 1) through the portfolio to serve as a guide to the reader. Both of these tools are designed to help the reader to locate items of specific interest and to underline the relative importance of each submission with respect to the achievement of academic rigour and innovation in the application of knowledge.

Submission 1, in which work conducted in the first year of registration was reported, has been included in the submission overview (Table 1) in order that the achievements of this particular piece of work can be acknowledged. The work contributed to a collaborative research project, but addresses the technological issues with which that project was concerned. Therefore, Submission 1 does not include work which is essential to the main theme of this portfolio, and it is not considered necessary for the reader to refer to it. For this reason, it will be noted that Submission 1 has been omitted from the portfolio "route-map", Figure 1.

Table 1 Overview of Portfolio Submissions

Submission	Issue/Research Question	Main Research Method	Outcomes, *Achievements*, ***Innovation***
Submission 1: "Joining Techniques for Aluminium Spaceframes"	Establish appropriate joining techniques for the fabrication of aluminium spaceframes for automotive vehicles	Literature Review	1. In-depth understanding of lightweight vehicle technologies, knowledge of joining techniques and understanding of the key drivers for change 2. Insights gained into difficulties of conducting strategically important research through collaboration 3. *Publication of two journal papers in the "Journal of Materials Processing Technology"*
Submission 2: "Defining Best Practice in the Management of Collaborative R&D Projects"	Identify the "success" factors inherent in collaboration management	Literature Review	***1. A best practice model for collaboration management that is more comprehensive than previously reported in the literature*** 2. An understanding of the key drivers behind a current trend toward increased collaboration 3. An understanding of the problems associated with collaboration and the reasons for a lack of reported success in collaborations
Submission 3: "Research Methodology"	Identify an appropriate research methodology and research techniques to evaluate the performance of collaborations involving WMG	Literature Review	1. Case study research identified as appropriate methodology 2. Selection of projects to study as representative cases 3. Data organisation and analysis techniques identified 4. Project success criteria and success rating tables developed 5. Data collection questionnaires developed
Submission 4: Case Study Reports – Projects A-F	How successfully were collaborative projects involving WMG managed?	Case Study Research	*1. Comprehensive evaluation of performance of collaborative R&D projects involving WMG* 2. Established high degree of commonality between factors affecting success in individual WMG cases and "success" factors incorporated in best practice model (Submission 2)

Submission	Issue/Research Question	Main Research Method	Outcomes, *Achievements*, ***Innovation***
Submission 5: "Case Study Research Summary Report"	Are there any common themes or patterns evident across the case studies?	Cross-case analysis	1. Established the existence of a number of common themes and patterns across cases 2. Confirmed the existence of a high degree of commonality between the WMG case and the best practice model 3. Confirmed the existence of problems relating to a "cultural gap" between academia and industry in cases
Submission 6: "Developing a Framework for the Effective Management of Collaborative R&D Projects"	Develop a management tool that will increase the probability that a collaborative R&D project will be successful	Assimilation of case study findings and best practice Supplementary Literature Review Review by experienced practitioners	***1. Basic structure of Framework for the effective management of collaborative R&D projects developed*** 2. Established the wider applicability of the Framework to other university-industry collaborations, industry-industry collaborations and its applicability to funding bodies as a mechanism for project proposal evaluation
Submission 7: "A Handbook for Effective Management of Collaborative R&D Projects" and "User Pack"	Develop a management tool which incorporates a reference manual and diagnostic features	Supplementary Literature Review Implementation Trials	***1. Framework Handbook developed to include instructions for the use of the Framework and reference information*** ***2. Questionnaires and monitoring charts (a User Pack) developed as diagnostic tools to provide the user with early warning of potential problems and to enable the user to measure improvement and monitor progress against key success factors***

1.4.1 The Portfolio "Route-map"

The portfolio "route-map" indicates a logical path through the portfolio, as a guide for the reader, Figure 1. The route-map begins with Submission 2, a literature review which summarises the current body of knowledge in the field of collaboration management and concludes with the development of a best practice model. Submission 3 describes the research methodology used in the "experimental" stage of the work. The report describes the rationale behind the choice of case study subjects, the method of data collection, sources of evidence and analysis techniques used.

The results of the case study research are reported in a series of six Case Reports, collectively referred to as Submission 4. Each Case Report presents the findings of a single collaboration project (or case). It will be noted that the Case Study Reports (Submission 4) have been set aside from the main path through the portfolio. The research work generated a considerable volume of data as a result of the adoption of a case study research strategy, and it is acknowledged that it may not be necessary for the reader to examine the individual case study reports in detail in order to establish the efficacy of the work. Therefore, while the individual case study reports (Submission 4) have been submitted to the portfolio in order to demonstrate the depth and detail of the research conducted, the reader is advised that the Case Study Summary Report (Submission 5) identifies and discusses the main research findings and outcomes.

Submission 6 details the development of the Framework for the effective management of collaborative R&D projects, based on best practice and the case study research findings. Submission 6 also discusses the wider applicability of the resulting Framework, beyond WMG. Finally, Submission 7 presents the *Framework Handbook* and *User Pack*, the results of further development of the Framework into a usable management tool.

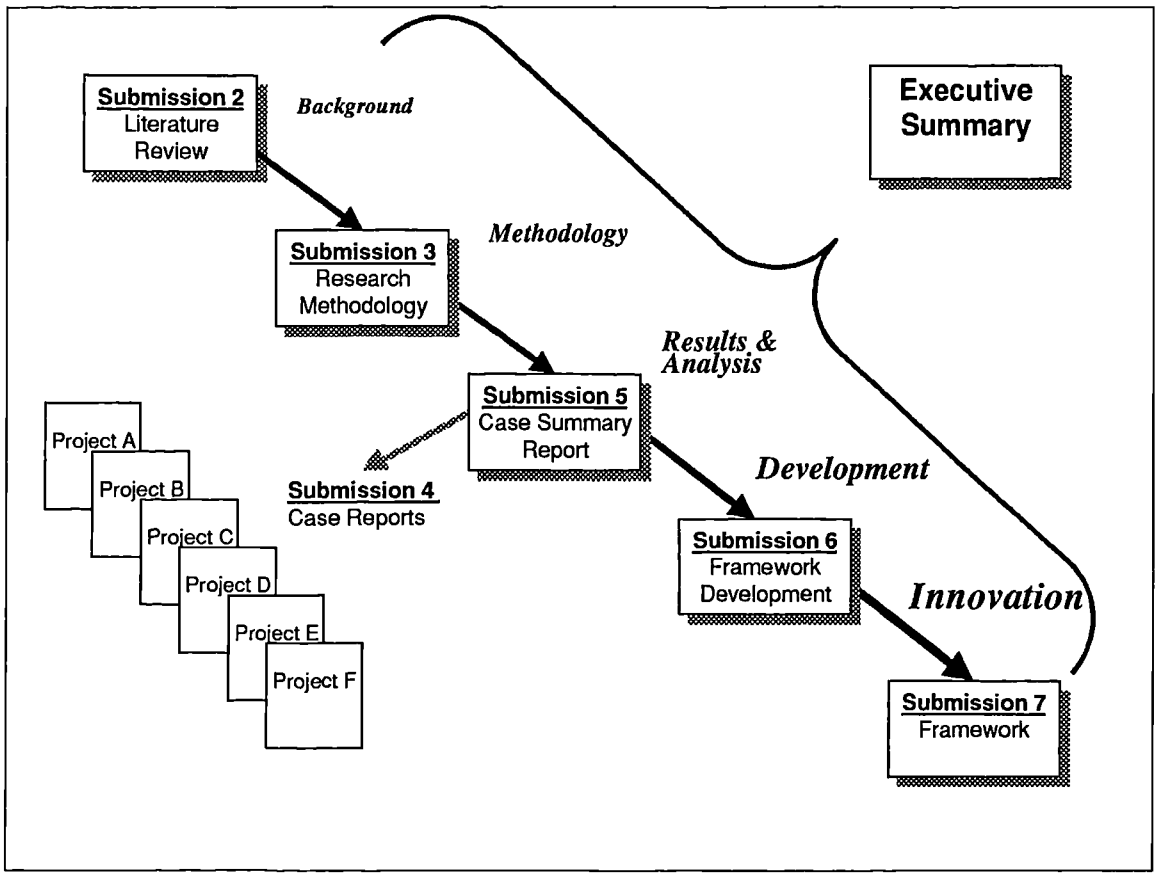

Figure 1 Portfolio "Route-map"

2. Preliminary Research

2.1 Best Practice Model in Collaboration Management

While the literature indicates that there are no universal definitions of "success" in collaboration, it has been suggested that the key to successful collaboration by any definition, lies in the way in which they are managed [28]. To this end, many workers have concentrated on identifying management factors which, if present, increase the probability that the venture will be considered successful. Research aimed at the identification of these management "success" factors therefore became the focus of the literature reviewed in Submission 2, Section 3.2, and subsequently provided the basis for the best practice model for collaboration management developed by the author, Figure 2.

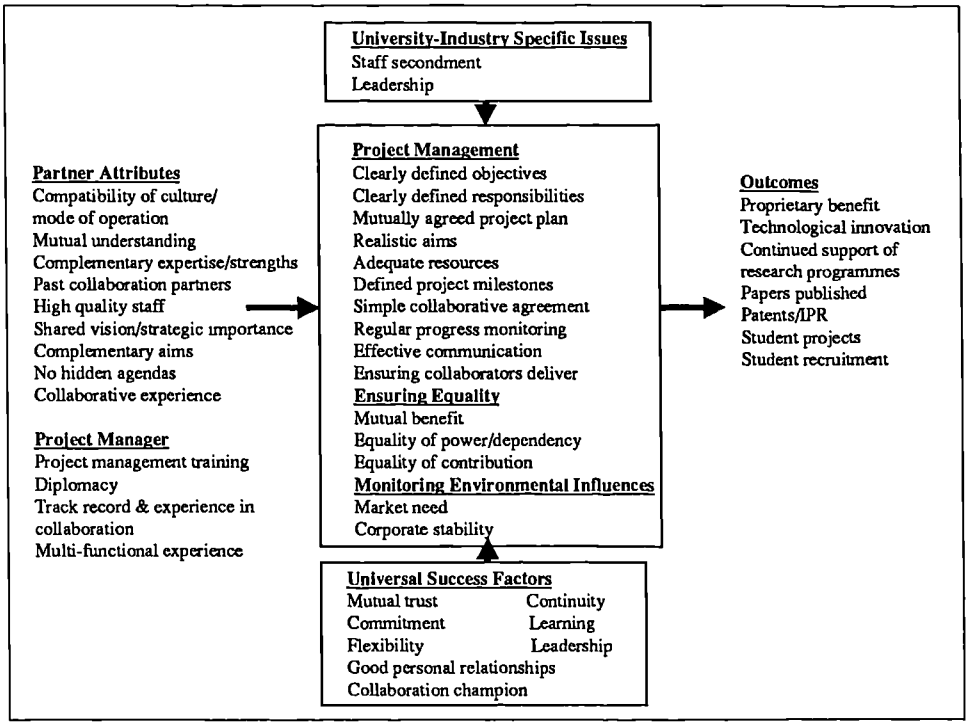

Figure 2 Best Practice Model for Effective Collaboration Management

Collaborations in which WMG were involved could then be compared against the best practice model as a means of identifying possible areas for improvement in current management practices.

On review of published research concerning factors shown to have a positive impact on collaboration success, a pattern of similar findings emerged. First of all, it was found that there are a number of "success" factors which are essentially generic, being generally applicable across a wide range of collaborative formats, e.g. strategic alliances, joint ventures, research consortia. Evidently, these generic "success" factors also apply across industrial sectors; the literature reviewed spanned studies of technological collaborations in the biotechnology, pharmaceuticals, electronics, telecommunications, information technology, automotive engineering, aerospace, and oil-exploration. Further, the regularity with which some of these factors appear in the literature would seem to indicate that they are of key importance to the success of collaboration (Submission 2, Section 3.2).

The majority of the literature available in the field of success factors in collaboration management, examined only collaborations between companies, i.e. industry-industry collaborations. Nevertheless, on comparison with similar investigations examining university-industry collaborations, a high degree of commonality was observed with respect to the "success" factors identified (Submission 2, Section 4.2). As such therefore, the element of the best practice model referring to university-industry specific issues contained comparatively few success factors, since many of the success factors identified were already accounted for in other areas of the model, Figure 2.

This suggested that the generic success factors identified were applicable to both industry-industry and university-industry collaborations. Therefore, a best practice model developed on the basis of these "success" factors could potentially be applied to a wide range of types of collaboration and industrial sectors, though clearly the emphasis on certain factors may change depending on the particular circumstances of each collaboration.

However, a related area of literature suggested that with regard specifically to university-industry collaborations, there were a number of additional issues which must be taken into account. These additional factors arise as a result of distinct cultural differences between academia and industry, a phenomenon referred to as the "cultural gap". The existence of a "cultural gap" between academia and industry, and the detrimental effects it can have on university-industry collaborations has been reported by several workers [13, 17, 22, 4, 24, 29-31]. These authors provide evidence that the cultural difficulties encountered within university-industry collaborations could constitute a significant obstacle to successful collaboration. Gregory [13] summarises a number of points which immediately illustrate a significant cultural gap, i.e. conflicting interests/objectives, between industry and academia which must be bridged in order for collaboration to succeed:

- The academic culture of publishing research results in the open literature, versus a typical desire by industry to maintain data as proprietary in order to establish competitive advantage
- A considerable difference in priorities is evident in that industry is focused on near-term, low risk research, leading rapidly to a new product in the market, compared to academic aspirations to longer term, more fundamental research, with the eventual realisation of an application. An inevitable time-frame conflict therefore also arises

- A perception of university researchers by industry as having a *laissez-faire* approach to research
- Concern among academic researchers that collaborative research with industry will lack the flexibility to pursue unanticipated, but interesting and potentially valuable research directions
- Conflict regarding the ownership of IPR arising from a partnership

For a more detailed discussion of the issues raised specifically with respect to the "cultural gap" the reader is referred to Submission 2, Section 4.1. Clearly, consideration of such issues were important in the context of evaluating collaborations in which WMG was an academic partner. However, while these factors were taken into account in the analysis of the case study data (Submission 4 & 5) and subsequently also featured in the Framework for effective collaboration management (Submissions 6 & 7), they were not incorporated into the best practice model for collaboration management developed in Submission 2, Section 5.

The main reason for this was that these factors were essentially "failure" factors, i.e. factors which could contribute to the failure of a collaboration. The best practice model was designed to incorporate "success" factors. Furthermore, these factors were essentially cultural issues and not management factors. Since these issues were taken into account in subsequent analyses (Submission 5 includes a discussion of the occurrence of such issues in the case study projects), their omission from the best practice model is not considered to have in any way affected the results of this research. However, in order to provide a more complete view of all of the factors considered to have either a positive or negative impact on the effectiveness of collaboration management, Figure 3 presents a modified version of the best practice

model originally presented in Submission 2. As a result, while other workers have presented models of success factors found to be relevant to their particular study or line of research (Submission 2, Section 3.2), the inclusion of "success" and "failure" factors identified by literature covering a wide range of research studies, means that the best practice model developed by the author (Figure 3) is the most comprehensive.

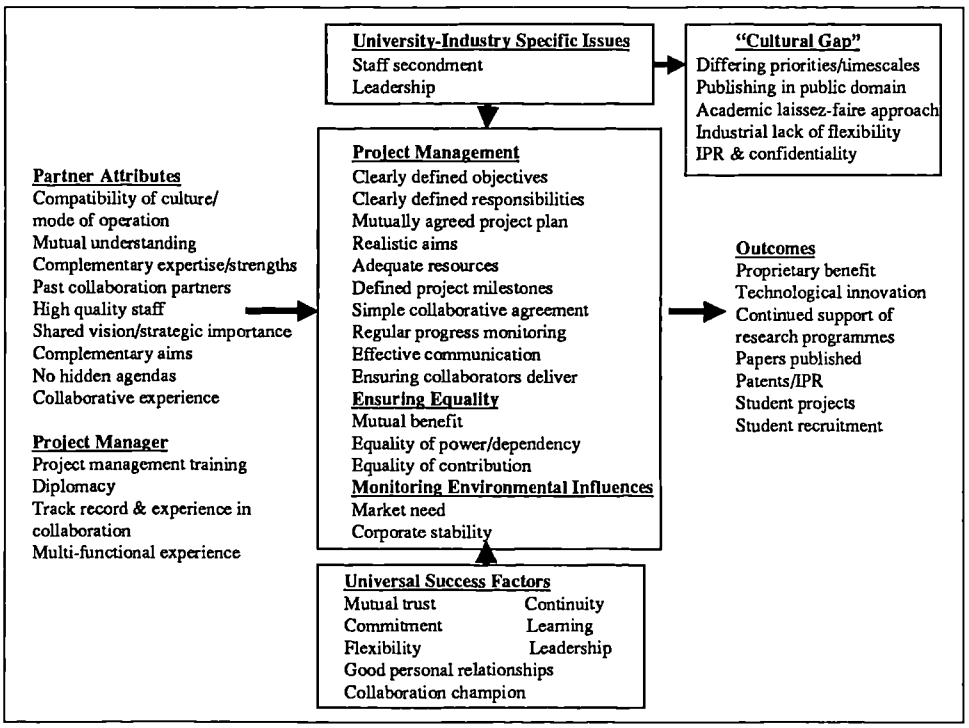

Figure 3 Modified Best Practice Model Containing Factors Associated with the University-Industry "Cultural Gap"

The above best practice model for collaboration management therefore constitutes a generic model against which management practice in collaborations could be compared. Furthermore, the model shows that the success factors identified are concentrated into key areas: *choice of partner*, the *project manager*, *project management, ensuring equality, monitoring environmental influences.* The model also includes *outcomes* which indicate the benefits that should accrue from a successful

collaboration, *universal success factors*, i.e. factors which are not easily categorised into a specific area of collaboration management and factors associated with university-industry collaborations and the "cultural gap".

Further, the model organises these categories of success factors in such a way that it represents a total collaboration management process, beginning with the evaluation of partners and a project manager and ending with the emergence of a range of outcomes. The model therefore demonstrates the importance of managing the whole process in order to achieve success and not just individual elements of it.

2.2 A Framework for Effective Collaboration Management

The literature on which the best practice model was based indicated that research had not extended beyond the identification of a number of "success" and "failure" factors and their impacts on collaboration success. Very little work was found pertaining to how this knowledge could be applied in practice, to bring about improvements in collaboration management and thereby increase the rate of success in collaborations and the benefit obtained from them.

Furthermore, what little work had been carried out in this direction concentrated on one specific area only, e.g., partner evaluation, people management or project management. The work of Bailey *et al* [32] for example, presents a model for the evaluation of appropriate collaboration partners and as such provides some guidance in this respect. The work of Spekman *et al* [3] and also Brouthers *et al* [33] also present the results of their research in the form of guidelines aimed at making the process of partner evaluation more discriminating. Another example is the work of Porter Lynch [34] which whilst providing valuable insights into issues such as leadership and

interface management in the context of collaborations, again does not extend beyond this limited field.

Clearly, the importance of each individual element of the collaboration management process is such that in depth, dedicated research is not merely justifiable, but necessary. However, without some mechanism for bringing together these individual threads of research, such work is unlikely to increase the probability of collaboration success because each individual area effectively ignores the influence of factors in other elements of the collaboration process. A coherent solution is required which brings together the results of research into these individual areas and in doing so, provides the collaboration practitioner with a management tool (a Framework) which facilitates the effective management of the whole process, from the initial planning stage through to measuring the outcomes.

This therefore, is the basis on which this research was conducted. The remaining sections of this document describe the main body of this research, reporting on the major research findings, the development of the Framework (on the basis of these findings), implementation and finally, discusses the wider applicability of the resulting Framework.

3. The Case Study Research

3.1 Research Strategy

The objective of the case study research was to determine how WMG and its industrial partners compared to best practice in the management of technological collaborations. This evaluation was necessary in order to identify areas where improvements could be made to the way in which WMG's collaborative projects are managed. The findings could then be used, with reference to the current body of knowledge, to develop a Framework for the effective management of WMG's collaborative R&D projects.

The principal means by which the case study research would determine whether or not WMG and its partners were demonstrating best practice in collaboration management, was through direct comparison with the best practice model developed from the literature. However, since the best practice model consists of a large number of generic success factors, applicable across a wide range of collaboration types and industry sectors, it is probable that some factors will have a greater influence on collaboration success than others, in the specific context of this study. Furthermore, many of the factors which make up the best practice model were derived from industry-industry collaborations. Therefore, despite some evidence to suggest that they are equally applicable in the university-industry context, it was by no means clear that their influence on the success of the case study projects would be significant. This indicated that, in the first instance, the research strategy should include some means of evaluating the success of the projects, as the basis for establishing the significance of any influential factors identified.

3.1.1 Measures of Collaboration Success

The literature has shown that there is no universal definition of "success" in collaborative terms, or a standardised means of measuring it. For the purposes of this study, four success measures considered appropriate in this context, were therefore developed with reference to related areas of published research (Submission 3, Section 6.1). These measures were:

- *Meeting Partners Objectives* – a measure of the extent to which the objectives of the project's partners had been met
- *Mutual Benefit* – a measure of the extent to which the project had been perceived as mutually beneficial by all parties involved
- *Overall Success* – measured partner's perceptions of overall project success
- *Technical innovativeness* – an objective measure of success based on tangible evidence of technological innovation resulting from the project

The literature showed that participant's perceptions are extremely important in the context of collaboration success (Submission 2) and the first three success measures therefore reflect that importance. However, perceptions are highly subjective and it is therefore inappropriate to base inferences of success or failure solely on such judgements. The fourth measure, *technological innovativeness*, therefore provides an objective measure of *actual* success as a means of validating these subjective judgements.

If a project failed more than two of the above success measures it was deemed to have failed, whilst success by more than two of the measures was considered to denote overall success. A project which scored two failures and two successes indicated a borderline result. For a more detailed account of the process by which these success

measures were established, the reader is referred to the Research Methodology report (Submission 3, Section 6.1).

3.1.2 Comparison with Best Practice

Comparison between the case study research findings and best practice was carried out by analysing the data collected for evidence of the management success factors incorporated in the best practice model. Establishing the presence of these success factors and any positive impacts from them, would suggest that WMG and its industrial partners were demonstrating best practice in collaboration management. Similarly however, if it could be shown that the *antitheses* of these success factors were having a *negative* impact on the collaborations studied, this would indicate that WMG and its partners were not demonstrating best practice.

For example, if it could be shown that the aims of the collaboration partners were not complementary, this would suggest that the success factor *complementary aims* had not been achieved and that best practice in the evaluation of appropriate collaboration partners had not been demonstrated in this respect. Furthermore, if the evidence indicates that this *lack of complementary aims* had a negative impact on the collaboration, it could be concluded that this success factor is an influential one in the context of collaborations involving WMG and its industrial partners and should therefore be included in the Framework.

However, this strategy clearly assumes that all possible management factors likely to have an influence on success have been identified and accounted for in the best practice model, i.e. there is a risk of possible threats to *internal validity* [35]. Therefore, it was equally important to analyse the data for evidence of other, not previously identified influential factors.

Finally, the literature (Submission 2, Section 4.1) showed that within university-industry collaborations specifically, a number of issues can arise as a result of distinct differences in the interests, priorities and values of academia and industry. Clearly, such differences in perspective and philosophy could have a negative impact on the success of a collaboration. Therefore, the data collected was also analysed for evidence of negative impacts as a result of a "cultural gap" between WMG and its industrial partners. A brief outline of the method of analysis used is given in Section 3.4.

3.2 Case Selection

Since it was the management of collaborations involving WMG as an academic partner which was the subject of the research, this study defined the *unit of analysis*, or "case", to be individual collaborative projects in which WMG was involved [36]. The majority of the joint research projects in which WMG are engaged involve the automotive industry or the aerospace industry, and it was therefore logical to select cases from within those industries, in order that the results of the study would be representative of the WMG research portfolio. Further, since the number of cases which could be studied was limited, it was logical to choose cases which were effectively "polar types", i.e. examples which demonstrate the two extremes of the phenomenon of study

[37, 38]. Therefore, another key differentiating factor in selecting the cases centred on collaborative projects which were generally perceived to be either largely successful or substantially failing. Such a strategy would ensure that the study focused on differences in management practices that might account for such substantially different results. On the basis of these criteria six case study projects were identified for investigation.

The first five projects were components of a larger research programme and as such provided a natural multiple case study. The benefit of studying projects from a common research programme was that this complied with the recommendation that cases be selected in such a way as to set boundaries around the study, thereby limiting the extent of environmental variation [37]. The circumstances and conditions within each of the projects, or cases, were broadly similar because they were set-up by the same Lead Partner and were set-up at the same time, to contribute toward a common goal. At the same time, each project incorporated different Lead Partner and WMG personnel, different partner companies, and were charged with delivering different aspects of the problem that the common research programme was set-up to address. Therefore, while the common arrangements shared by the projects limited the extent of environmental variation, there was still scope for considerably different outcomes.

Furthermore, since the research programme was essentially based in the automotive sector, these projects could be regarded as representative of WMG's research portfolio. In addition, cursory investigations suggested that whilst some of the projects within the programme were perceived as achieving some degree of success, others appeared to be failing. Collectively therefore, these projects presented the study

with examples of polar types. To this end, all five active projects were included in the case study research.

However, despite the many advantages of studying these projects as a natural multiple case study, it was noted that the existence of numerous strong vertical (customer-supplier) relationships within the projects was likely to influence the results of the investigation. Since in many cases the Lead Partner was a significant customer for the companies participating in the research programme, it was recognised that these companies were therefore likely to be to some extent pre-disposed to involvement in it. In fact, the involvement of the Lead Partner, an automotive manufacturer, was to a great extent used to leverage industrial support.

To this end, an additional case study project was added as a control for the inherent influence of the vertical relationships in the multiple case study. It was anticipated that if these strong vertical relationships were distorting the influence of the management success factors, the additional case study would give different results. Therefore the sixth case study project acted as a control for the vertical relationships in the first five cases, providing a means by which any influences attributable to these relationships could be identified and accounted for.

The additional case was selected primarily on the basis that it involved no customer-supplier relationships. The collaborating companies in this project were all potential end-users for the technology being developed. Furthermore, the project was essentially an aerospace collaboration, an industry sector which is also strongly represented in WMG's research portfolio.

Another consideration in the selection of this additional case was the need to find a collaborative research project which had been set-up on a similar basis to that of the first five cases. This would contain the number of variables and potential extraneous influences on the results to within manageable boundaries, facilitating the study of only those influences that are of principal interest. It was noted that the sixth case (designated Project F) had the following features in common with the multiple case study (designated Projects A-E):

- Project F was funded under the same government initiative as two of the multiple case study projects (though for the Aerospace rather than the Land Transport Sector), and as such the terms of the funding, and the partners contributions to it were similar, as were the general programme objectives,
- Project F was therefore also an industry-lead project, managed by one of the industrial partners, and had the same three-year duration as Projects A-E,
- WMG were involved in Project F, though as with each of the other five cases, the individuals representing WMG on the project were different,
- Project F is a technology-based research collaboration, as were Projects A-E,
- The terms of the collaboration agreement were similar to that of Projects A-E,
- At the time that the interview data was collected, Project F had reached approximately the same stage of the collaboration, i.e. entering its final year.

One notable difference between Project F and Projects A-E (other than the difference in industry sector) was the involvement of more than one university. In Project F, WMG was partnered by two other universities, each university offering a distinctly different field of expertise. It was considered that this feature was unlikely to introduce any additional influences that have not already been accounted for, though

through the involvement of the two additional universities, there was the opportunity to gain additional insights into the relationships and cultural differences between academia and industry within this type of collaboration. This feature was therefore considered an additional benefit of Project F.

3.3 Data Collection

The principle source of evidence used in this study was that of interviews, a key source of case study information [35, 36]. In each of the cases studied, project participants from the collaborating companies, academic researchers, and where applicable, any technical staff having direct involvement in the projects, were asked to give an interview.

To ensure a consistent approach to each interview, i.e. to ensure that the same issues were raised in each case, the interviews were carried out in a semi-structured way [39], using a questionnaire. The use of a questionnaire meant that direct comparisons could be made with regard to respondents views on the issues raised. The design of this questionnaire is described in Submission 3, Section 5.

Since multiple sources of evidence are considered to provide more robust support to the findings of case study research, these interviews were supplemented by other sources of evidence [36, 37, 40]. The other sources of evidence available for this study included:

- Documentary evidence in the form of minutes of meetings carried out during the project, and progress reports.
- Archival records in the form of the financial reports of the companies involved in the collaborations.
- Direct observations through attendance at steering committee meetings, in some cases.

Since Projects A-E and Project F had not been completed at the time that the interview evidence was being collected, it was considered important to obtain a sample of up-dated views from participants when these projects came to an end mid-1999. To this end, a follow-up questionnaire was sent to participants (this time by post) in order to capture these views. This questionnaire was designed to highlight any changes in the views of participants since the original interview and to record the final outcomes (both tangible and intangible) from each of the projects.

Finally, background information from company reports was used to further develop the contextual issues regarding each case. It was considered that such information could be important in strengthening *external validity,* in drawing attention to possible alternative influences which might explain certain events, decisions made, or specific problems which arose.

3.4 Data Organisation & Analysis

The study of the Projects A-F generated a large volume of interview data, particularly given the substantial use of open-ended questions in the questionnaires (Submission 3, Section 5.2). However, in order to ensure *reliability* in the application of the case study research methodology, it was important to develop a set procedure for the organisation and analysis of the data (Submission 3, Section 6.2) [36, 37].

The approach taken was to group responses pertaining to the same or similar issues into categories. This technique proved most effective in identifying the respondents' main concerns. Furthermore, this technique allows the researcher to identify patterns of similarities or differences, both within a case and across cases [35, 37, 40].

Appropriate categories were defined on the basis of the data collected and with reference to the major categories of success factors identified in the literature [37]. For clarity, the analysis concentrated on only the most frequently cited issues, which were assumed to be the most significant. The responses grouped under each category were tabulated for ease of reference and comparison with other cases. However, where an issue was only raised a small number of times, but was nonetheless considered important in the context of the study or a particular project, the issue was noted and raised for discussion in the case study report.

Aside from providing a clear impression of what the major issues were in each project, the categorising of responses in this way also facilitated discussion. The grouping together of all comments relating to a particular issue allowed for the different view points and interpretations expressed, to be compared and contrasted. Further, any additional information and relevant facts drawn from other information sources, e.g. meeting minutes, could also be brought into the discussion to verify the findings.

Having categorised the main issues to arise from the interview data (verified where possible through the supplementary evidence), a direct comparison could be made with the best practice model for collaboration management. The compilation and tabulation of the case study evidence in this way, greatly facilitated the process of relating the main issues raised, to the management factors identified in the best practice model. Similarly, by grouping together evidence pertaining to issues raised with respect to the "cultural gap" between academia and industry, it was possible to draw conclusions about the effect of cultural differences on the case study projects.

3.5 The Main Findings

The case study research findings, using the four success measures described in Section 3.1.1, showed that of the six projects studied three were successful, two were classed as "borderline" and one was deemed a failure. This indicates that, in at least one case, WMG and its industrial partners did not demonstrate best practice in managing collaborations. Furthermore, in all six cases there was evidence of negative impacts as a result of failing to apply best practice in certain areas. Therefore, while the negative impacts were only severe enough to cause project failure in one case, the evidence indicates that there was some scope for improvement in all six projects.

Tables 2 and 3 summarise the findings for each project, listing all factors found to have had either a positive (Table 2) or negative impact (Table 3). Table 2 shows that the positive impacts identified were associated with the presence of success factors identified in the best practice model, Figure 3. Similarly, it was found that the *antitheses* of success factors (Table 3) identified in the best practice model, had a correspondingly negative association on the projects concerned. For example, *mutual trust* is identified in the best practice model as an important Universal Success Factor which, if present, would be expected to have a positive impact on the success of the collaborative projects. In contrast however, the presence of the *antithesis* of trust, *mistrust* in Project A, was found to have had a negative correlation with the success of that project.

These positive and negative factors have been categorised according to the main areas of the best practice model for collaboration management, i.e., universal success factors, partner attributes, project management, ensuring equality. This was done in order to demonstrate the degree of fit with the best practice model and also to facilitate the identification of patterns of similar factors arising across cases.

Table 2 Summarised Results of Case Study Research (Positive Impacts)

Project Name	Project A	Project B	Project C	Project D	Project E	Project F
Status	*Failure*	*Borderline*	*Borderline*	*Success*	*Success*	*Success*
Universal Factors	Good personal relationships (between Lead Partner & WMG)					Good personal relationships (between Lead Partner & WMG)
Partner Attributes	Complimentary aims	Complimentary expertise/strengths	Complimentary aims	Complimentary expertise/strengths	Complimentary expertise/strengths	Strategic importance
	Complimentary expertise/strengths		Complimentary expertise/strengths			Past collaboration partner
	Collaborative experience					
	Past collaboration partner (WMG & Lead Partner)					
Project Management			Clearly defined responsibilities		Effective communications	Effective communications
Outcomes					Tangible outcomes	

Table 3 Summarised Results of Case Study Research (Negative Impacts)

Project Name	Project A	Project B	Project C	Project D	Project E	Project F
Status	*Failure*	*Borderline*	*Borderline*	*Success*	*Success*	*Success*
Universal Factors	Mistrust	Lack of commitment of partners	Lack of commitment of partners	Lack of commitment of partners	Mistrust (among competitors)	Lack of continuity (of project manager)
			Lack of continuity (of project manager)			
Partner Attributes	Suspected hidden agendas	Lack of collaborative experience	Lack of collaborative experience	Hidden agenda (customer-supplier relationships)	Non-complementary aims	
		Hidden agenda (customer-supplier relationships)	Hidden agenda (customer-supplier relationships)	Partner instability		
Project Manager			Inexperienced project manager			Inexperienced project manager
Project Management	Lack of clearly defined objectives	Lack of clearly defined objectives	Lack of clearly defined objectives	Lack of progress monitoring		Lack of clearly defined objectives (tendency to "over-promise")
	Lack of clear roles & responsibilities	Lack of clear roles & responsibilities	Lack of progress monitoring			Inadequate project planning
	Inadequate project planning	Initial lack of progress monitoring	Inadequate project planning			Poor project monitoring
	Unrealistic aims	Inadequate resources (lack of skills & training)	Ineffective communication (poor reporting & meeting structure)			Unrealistic aims (of industrial partners)

Project Name	Project A	Project B	Project C	Project D	Project E	Project F
	Lack of project monitoring	Inadequate project planning	Inadequate resources (too few researchers & too inexperienced)			Inadequate resources (over-extended partners)
	Ineffective communication (poor reporting & meeting structure)	Ineffective communication (poor reporting & meeting structure)				
	Inadequate resource planning					
Ensuring Equality	Lack of mutual benefit					
Environmental Factors	Corporate instability	Corporate instability		Corporate instability	Corporate instability	
Outcomes	Inadequate proprietary benefit for partners			Inadequate proprietary benefit for partners	Inadequate proprietary benefit for partners	
Cultural Issues	Differing priorities/timescales	Differing priorities/timescales	Differing priorities/timescales	Differing priorities/timescales	Differing priorities/timescales	Differing priorities/timescales
	Academic priorities took precedence	Students have own agenda	Students have own agenda	Academic right to publish	Academic right to publish	
		Academic right to publish				

Cross-case examination of the findings in Tables 2 and 3 indicated that patterns of similar factors did exist among the cases. A high incidence of negative factors associated with *partner attributes* and *project management* was particularly evident. Within these categories a number of individual factors recur in a number of cases, e.g. *partners not delivering* and *lack of clearly defined objectives.* The emergence of such patterns indicates that a standardised solution or Framework would be useful in improving the effectiveness of collaboration management in future projects.

The high degree of commonality between the case study findings and the management success factors identified in the literature (as represented by the Best Practice Model), is more clearly illustrated by Figure 4.

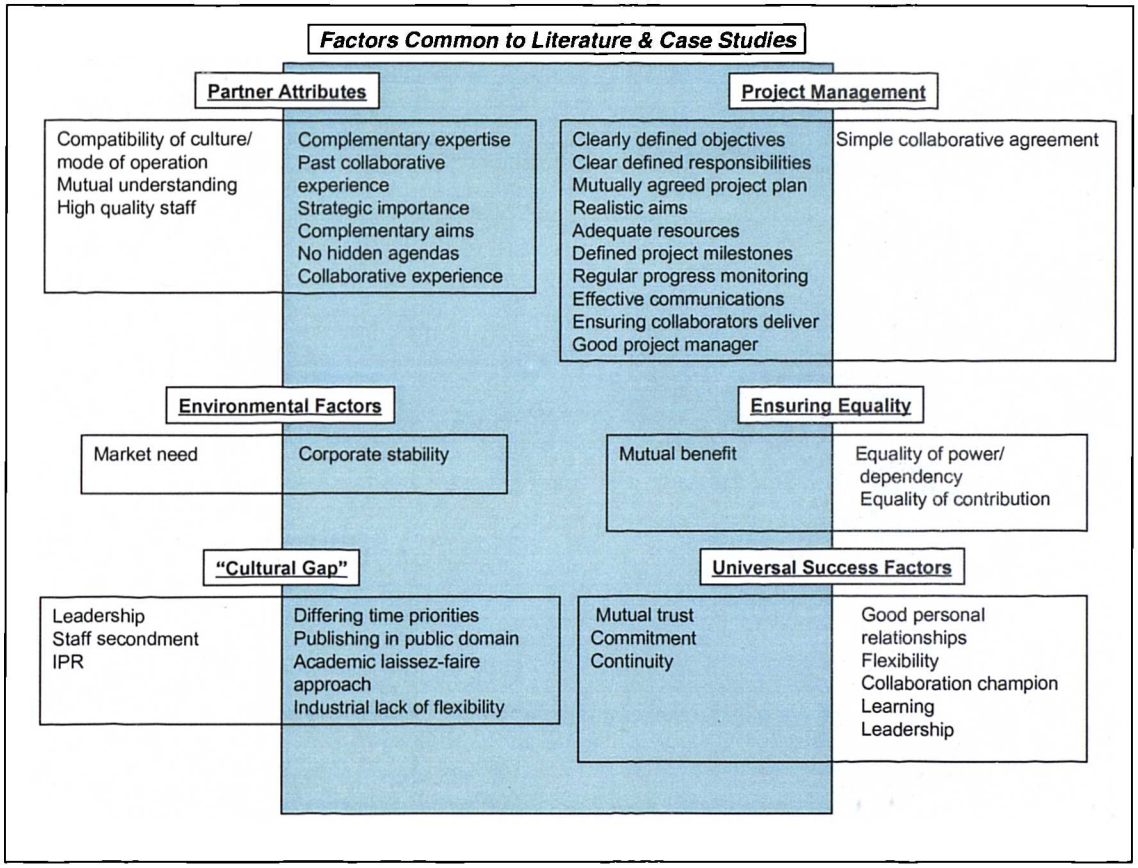

Figure 4 Degree of Commonality between Best Practice Model for Collaboration & Factors Negatively Represented in the Case Study Findings

In Figure 4, the factors identified from the case study research as having had an influence on collaboration success were compared with the management success factors represented in the best practice model, in order to determine the degree of fit. All factors shown within the *green box* were identified as success factors in the literature (present in the best practice model) *and* were also found to be influential to success in the case study projects. Those factors that fall outside the *green box* are factors which, whilst identified as success factors in the literature, were *not* found to have been influential with respect to the case study projects.

The high degree of commonality between the literature and the case study findings, as demonstrated in Figure 4, shows that collaborations involving WMG are not untypical of other collaborations studied and reported in the wider literature. This indicated that the Framework Management Tool, designed to enhance collaboration management and developed on the basis of the case study research, has a broader potential applicability beyond WMG. But this analysis also enabled the basic structure of the Framework Model to be defined. Figure 4 indicates which of the management success factors incorporated in the Best Practice Model were especially influential with respect to the case studies. These factors therefore were given the greatest emphasis in developing the guidelines for effective collaboration management. Success factors which proved less influential with respect to the case study projects, were corresponding given less weight in developing these guidelines.

For example, the analysis showed that both the literature and the case study research identified the need for a *good project manager*. This factor was therefore included in the basic structure of the Framework Model (*Project Manager Selection*). But clearly what constitutes a "good" project manager in the context of collaboration management had to be defined. This definition of the attributes associated with a "good" project manager was therefore derived from best practice knowledge contained in the literature, and knowledge generated through the case study research. Similarly, the

analysis showed that factors associated with collaboration partners were common to both the literature and the case study research, e.g., *complimentary expertise, strategic importance* and *no hidden agendas.* Therefore, in structuring the Framework Model, the *Partner Evaluation* element was developed in order to address these issues. The criteria for partner evaluation developed for the Framework Model, combines these common success factors with best practice knowledge and knowledge generated through the case study research.

Submission 5, the Case Study Research Summary Report presents a detailed discussion of the common issues to arise from the cross-case analysis of the case study research data. For a detailed discussion of how the results of the above analysis were used to define the Framework Model and the Framework Management Tool, the reader is referred to Submission 6.

4. The Framework

4.1. The Basis for a Solution

In establishing that WMG and its industrial partners were not always applying best practice in key areas of collaboration management, the case study research provided important indications as to where improvements could be made for future collaborations. Furthermore, the degree of fit between the case study findings and the best practice model indicated that in developing the solution (the Framework for effective collaboration management), the learning from the case study research could be combined with relevant research from the literature. This would produce a management tool that was tailored to the specific needs of WMG and its industrial partners but could also incorporate within it, relevant aspects of the current body of knowledge. Such a tool would provide for the effective management of future projects therefore increasing the probability that these projects will be successful. Further, the Framework would be developed in such a way that it can be systematically applied and would not assume prior experience of collaboration management or familiarity with the current body of knowledge on the part of the user.

The best practice model for collaboration management identified a number of critical success factors which were not found to have been applicable to the case study projects. This is to be expected since the best practice model incorporates success factors identified from a wide range of research into a number of different types of collaboration. Therefore, in developing the Framework, it was assumed that factors which were not represented in the case study findings were not critical to success in the context of research collaborations involving WMG.

In this way, the development of the Framework drew on the findings of the case study research to determine its basic structure and set boundaries around issues relevant to the context in which it would be applied. This basic structure was then supplemented with relevant elements of the current body of knowledge presented in the literature. The basic tenets of this solution, including a brief outline of the resulting Framework for effective management of collaborative research projects, is presented below.

4.2 The Basic Structure & Rationale

The basic structure of the Framework incorporates elements which reflect both the case study findings and the best practice model, Figure 5. The inclusion of *Partner evaluation* and a project management stage (*Project Set-up and Execution*) reflect the importance placed on these issues in the case study research and also in the literature.

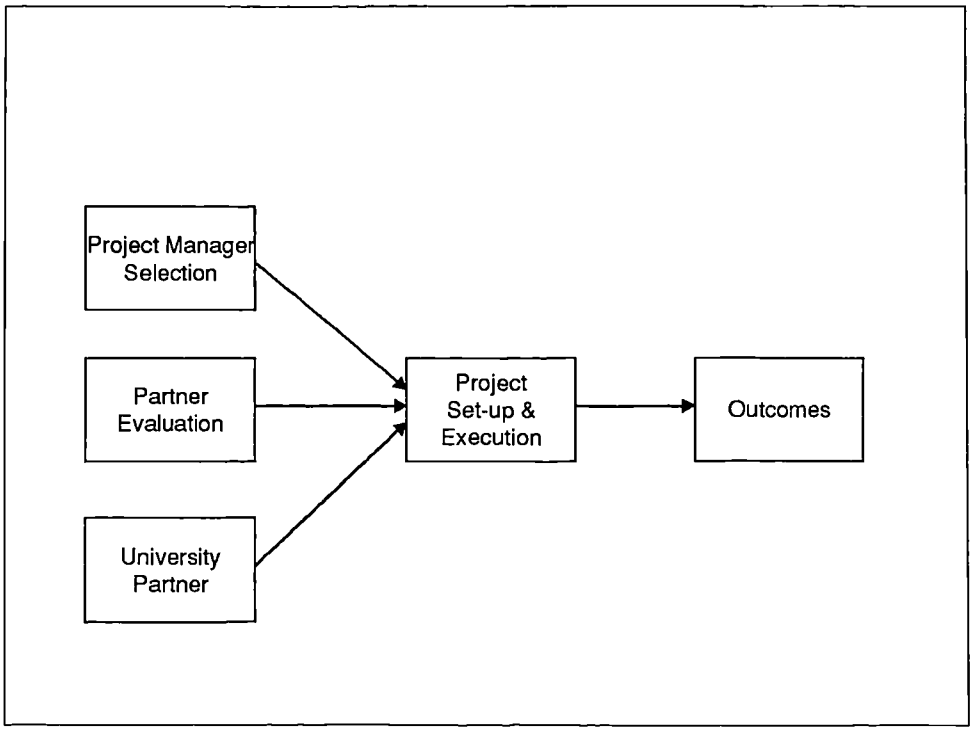

Figure 5 Basic Model of the Framework for Effective Management of Collaborative R&D Projects

Choosing appropriate collaboration partners is regarded in the literature as being the most important element influencing collaboration success (Submission 2, Section 3.2.1.1) and the case study research provides further evidence to support this. A number of the industrial partners were involved in Projects A-E purely as a means of cultivating a closer relationship with the Lead Partner (an important customer for many of them). As a result many displayed an almost complete disinterest in the research itself, and this was shown to have had a number of negative impacts on these projects. This stage of the Framework therefore provides a partner evaluation process, whereby the collaboration initiators can assess partners for potential risk factors which, left undetected, could jeopardise the success of the collaboration. In identifying these risk factors the Project Manager is therefore afforded the opportunity for risk mitigation.

Similarly, the inclusion of a *Project Manager Selection* stage reflects both the importance placed on high quality project managers in the literature and case study evidence indicating that inexperienced or ineffective project managers had a negative impact on the projects studied. This stage of the Framework therefore provides guidance on the selection of appropriately skilled and experienced project managers, based on learning from both the case studies and the research reported in the literature.

The *University Partner* stage is aimed at resolving important issues associated with academic-industry relations and project management effectiveness. For example, the case study research demonstrated the importance of ensuring that a certain amount of project management responsibility is undertaken by the academic partner's research team. It was found that where the project management task was divided between the industrial Project Manager and the academic Lead Researcher, the projects tended to run more smoothly and academic-industrial relations benefited.

Finally, the *Outcomes* element of the Framework constitutes a performance measurement stage. This performance measurement concentrates on identifying benefits to emerge from a collaboration, determining whether or not *mutual* benefit has been achieved among the partners and whether or not the partners perceive the collaboration as successful with respect to the realisation of adequate *proprietary* benefit, i.e. benefits commensurate with the investment/risk borne by each partner (Submission 2, Section 3.2.1.4). Mutual benefit with respect to the balance between academic and industrial outcomes is given particular attention.

The Framework constitutes, in effect, a project management process, but one which is specifically designed to address the management of *collaborative* projects. The interrelationships between the elements clearly reflect the step-by step approach of a typical project management process, whereby the project begins with the formation of a project team (*Partner Evaluation* and *Project Manager Selection*) and progresses through the stages of *Project Set-up and Execution* to the monitoring of the achievement of agreed targets (*Outcomes*).

However, as a project management process, it became evident that the Framework required two additional stages to precede the collaboration process itself, in order to be considered complete. These additional stages were *Initial Project Scoping* and *Preliminary Study*, Figure 6.

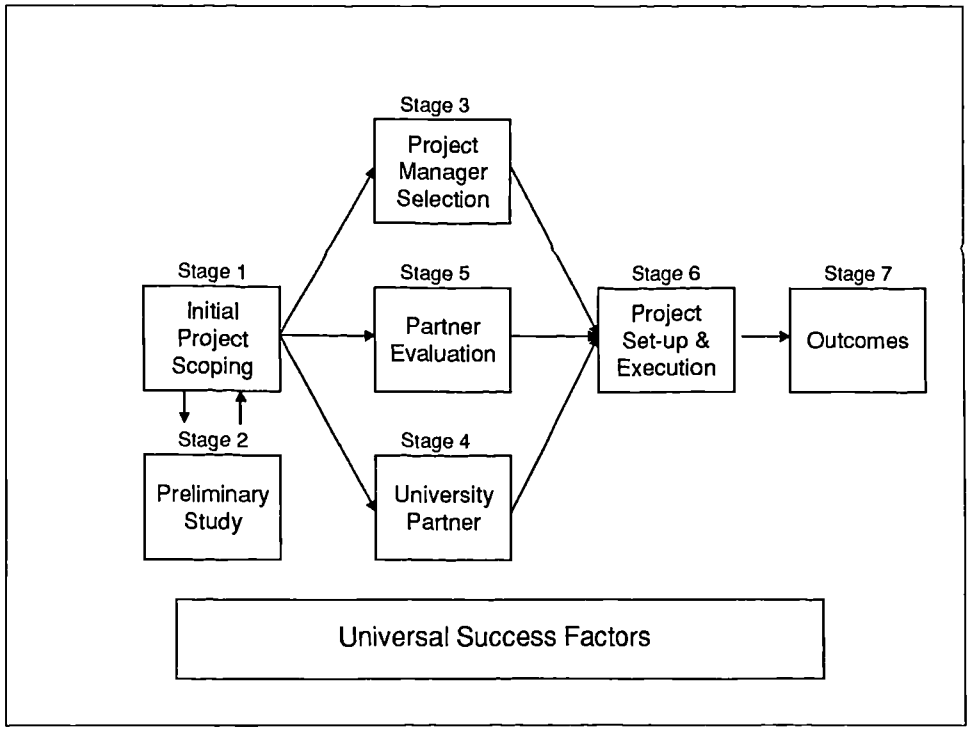

Figure 6 Complete Project Management Process for Effective Management of Collaborative R&D Projects

The rationale behind the *Initial Project Scoping* stage is that the project initiators will need to have some idea of the project's scope and objectives before involving collaboration partners. It was evident from the case study research that effective initial planning would have substantially reduced delays and problems as a result of unrealistic aims, unclear objectives and inadequate resources in some projects (Submission 5, Section 2.2).

The *Preliminary Study* stage is aimed at prompting the project initiators to consider whether some preliminary work to refine the project's scope, may be beneficial prior to the collaborative project itself. Again, it was evidence arising from the case study research that provided indications that such preliminary work may be of benefit (Submission 5, Section 2.2).

It is noted that Figure 6 also includes the *Universal Success Factors*. These factors, though shown in the literature and in the case study evidence to be important, tend not to be easy to categorise, being for the most part relevant throughout the whole of the project management process. For this reason the *Universal Success Factors* are shown as a discrete element spanning the length of the process.

Similarly, while the Framework is aimed primarily at university-industry collaborations, the process does not include a distinct element addressing academia-industry cultural differences. The issue of overcoming the so-called "cultural gap" is regarded as central to the collaboration management process in this context and as such the recommendations and guidance provided throughout the Framework reflect this. The evidence presented by the case study research indicates that, despite the specific nature of the "cultural gap", the majority of the problems associated with it can be alleviated by good practice in collaboration management (Submission 5, Section 3.6). The harmonisation of academic-industry cultural differences is therefore integral in the structure of the Framework and as such does not appear as a separate and distinct element.

Since each element of the Framework addresses a range of issues and potential problems, it is not considered appropriate to include a detailed description of individual elements in this Executive Summary document. However, the rationale and the critical success factors associated with each element of the Framework process are described in Submission 6 (The Development of a Framework for the Effective Management of Collaborative R&D Projects). The reader is therefore referred to Submission 6 for details regarding individual elements of the Framework. The remainder of this section briefly describes how the Framework is to be applied and how it aims to aid the

collaboration practitioner in ensuring the effective management of research collaborations.

4.3 Applying the Framework

The Framework has been developed into a management tool, designed specifically for application to collaborative projects. To this end, the Framework consists essentially of two parts - a *Handbook* and a *User Pack.* The *User Pack* consists of a series of questionnaires, each of which focuses on a specific element of the Framework model. Each questionnaire is designed to draw the user's attention to certain important issues and to prompt the user to take action, where appropriate, to resolve issues that may adversely affect the smooth running of the project and therefore the success of the collaboration. The questionnaires are each based on the current body of knowledge in that area and supporting evidence from the case study research and as such, by applying the questionnaires the user is effectively gaining access to that knowledge.

Responsibility for applying the questionnaires lies primarily with the Project Manager. The Project Manager is responsible for the management of a collaborative project from the point of formation of the collaboration team, and as such is well placed to administer the *Project Set-up & Execution* and *Project Outcomes* questionnaires (Q-5 and Q-6). Further, since it has been shown that the behaviour of collaboration partners can have a substantial impact on the success of a collaboration (Submission 5, Section 4.1), it is also appropriate that the Project Manager conduct the partner evaluation element of the Framework management tool, through the *Partner Evaluation* questionnaire (Q-3). The *Project Outputs* questionnaire (Q-4) is designed to collect important information from the collaboration partners with regard to desired and

expected deliverables, and requirements for the communication of results and project progress. Responsibility for the analysis of the resulting data and its use in the project planning process again lies with the Project Manager. The Project Manager is also required to conduct the evaluation of the university partner(s), through the application of the *University Partner* questionnaire (Q-2). In evaluating the university partner, emphasis is placed on the efficient and effective management of the university's role within the collaboration, and as such the Project Manager is again well placed to make such an assessment.

However, responsibility for the assessment of candidates for the role of Project Manager lies with the senior management of the organisation responsible for project managing the collaboration. This organisation will typically also be one of the organisations responsible for the initiation of the collaboration [24]. The *Project Manager Selection* questionnaire (Q-1) is designed to enable senior management to objectively assess the Project Manager for skills appropriate to the successful management of collaborative projects. However, the Project Manager may also use the questionnaire as a means of self-assessment and in doing so, provide direction for personal development. The responsibilities of the Project Manager and those of other parties, with regard the application of the Framework tool, are clearly indicated on the Collaboration Chart (Figure 7).

The incorporation of a scoring system into each questionnaire, enables the user to assess performance against a number of criteria associated with each element of the Framework. For example, as part of the Project Manager Selection Questionnaire (Q-1) the user must respond to questions regarding the "management skills" of the prospective candidate. Responses to these questions will achieve a rating which can

then be transferred to a Collaboration Chart, Figure 7. The Collaboration Chart is partitioned into "High Risk", "Moderate Risk" and "Low Risk" zones and therefore by plotting (on the appropriate sector of the chart) the rating achieved by the prospective project manager against the "management skills" criteria, the user can assess the degree of risk inherent in their choice of candidate.

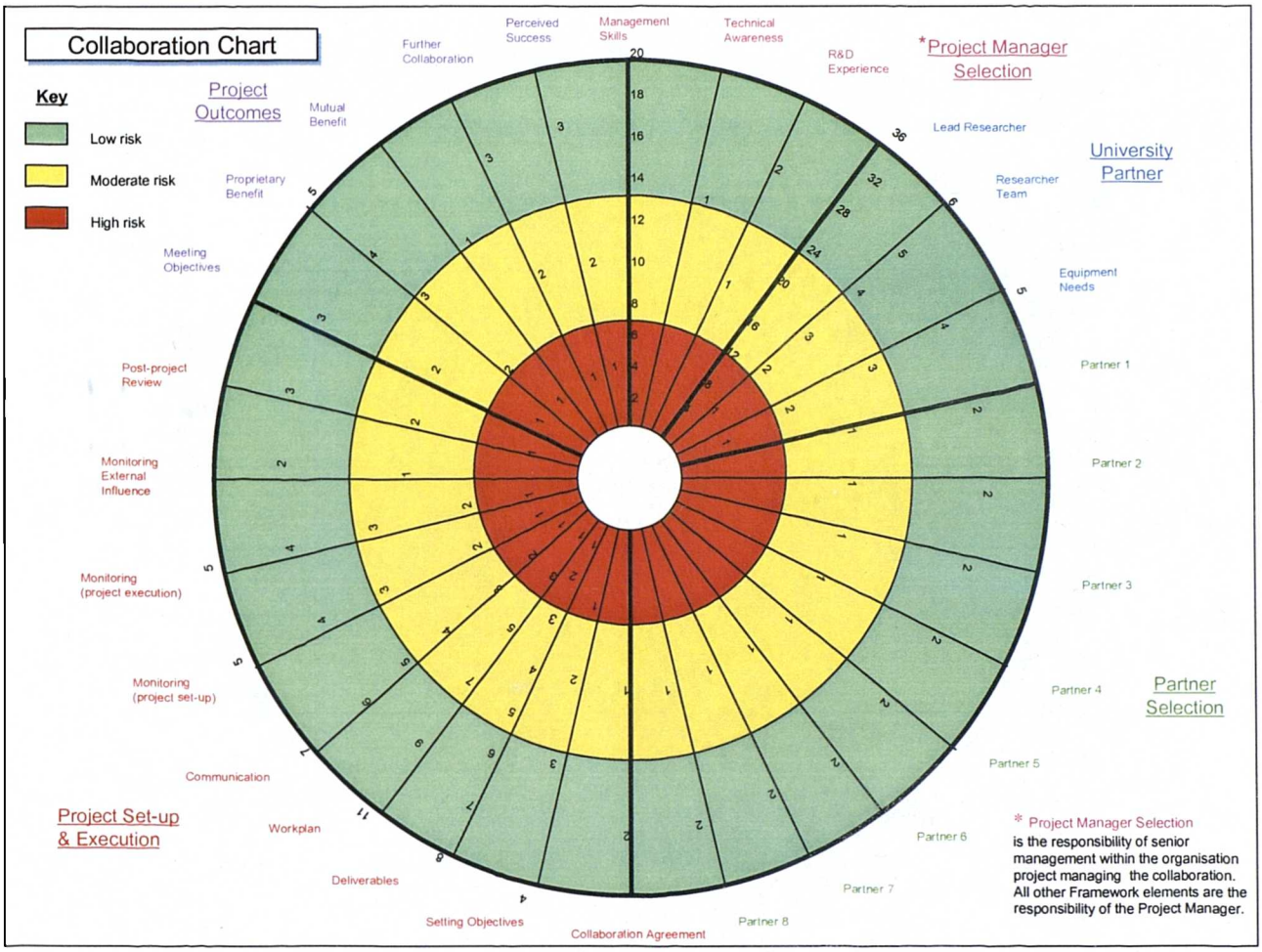

Figure 7 Framework Collaboration Chart

In this way, the user is provided with feedback on the degree of risk incurred at each stage of the collaboration process. Furthermore, by taking action to resolve some of the issues highlighted as being "High Risk" areas, the user can subsequently reduce the risk in these areas and therefore gain some measure of performance improvement

subsequent re-evaluations (re-application of the questionnaire). The Framework is not therefore purely designed as a performance measurement tool, it is designed to encourage continuous improvement throughout the collaboration.

It should be noted that despite the use of questionnaires and "High Risk" and "Low Risk" criteria, the Framework is not intended to be prescriptive. Despite being based on empirical research and the current body of knowledge, adherence to the guidance provided by the Framework will not guarantee collaboration success, though it should increase the probability of success. The Framework is intended to make the user aware of the important issues and factors which have been found to influence success, and to encourage the collaboration practitioner to take appropriate action based on this information.

As such therefore, if the application of the Project Manager Selection Questionnaire (Q-1) indicates that the project manager's lack of previous collaborative experience for example, makes him/her a "High Risk" choice, the user would not necessarily be advised to seek a replacement candidate. It may be that in every other respect the candidate has an exemplary record as a project manager. By applying the Framework the user is simply made aware of the fact that this may have an effect on the project manager's performance and hence on the success of the collaboration. An informed decision can then be made as to whether to do nothing, select another candidate or suggest that the prospective project manager prepare his or herself for the role by researching the particular problems associated with *collaborative* project management.

Since the questionnaires merely bring important issues to the attention of the user and do not explain these issues, the *User Pack* is supplemented by the *Framework*

Handbook. The *Handbook* serves a dual purpose in that it provides both instructions for the application of the Framework, i.e. its questionnaires and charts, whilst also providing a set of Guide Notes. These Guide Notes are essentially designed to inform the user of the background behind the issues being raised through the application of the questionnaires.

The Framework has therefore been designed not just as a means of informing collaboration practitioners, but also to facilitate the application of the current body of knowledge in a way which provides the user with timely feedback, encourages prompt action to prevent problems occurring, and encourages continuous learning and continuous improvement.

A copy of the Framework Handbook and User Pack has been included in this Executive Summary (Appendix A). The reader is however, advised that at the time of submission, these documents had not been fully tested. Plans for the further testing of the Framework model and management tool are detailed in Section 7.1.

4.4 A Review of Relevant Management Tools

A review of published literature showed that a Framework for effective collaboration management does not currently exist (Section 2.2). Frameworks of this kind do however exist in other, related areas. For example, Theory W a project management theory developed by Boehm & Ross [41] was generated as a solution to the particular problems inherent in the management of software development projects. Theory W achieves a coherent management process by bringing together a number of apparently unconnected factors and as such there are similarities with the Framework developed here.

However, while Theory W is to some extent applicable to collaboration management in that it too aims to overcome problems associated with the differing objectives and requirements of key participants, Theory W is aimed specifically at software development where the key players are the software developers, the users, customers and system maintainers. Therefore, while the general approach is applicable, it lacks certain key areas important in achieving effective collaboration management, e.g. partner evaluation and project manager selection (Submission 2, Section 5), as well as lacking elements which address the specific difficulties associated with academic-industry collaboration (Submission 2, Section 4). Furthermore, the Framework developed here is to be applied to R&D projects which involve more unknowns than a *development-only* project and are therefore inherently more high risk. Since Theory W is concerned with *development-only*, it therefore also differs from the Framework for effective collaboration management in this key respect.

In addition, the Theory W approach remains one of providing a set of guiding principles on which to base a development plan. It does not provide a set of tools with which to apply these principles. The Framework for effective collaboration management presented here has a built-in system of measurement by which the collaboration practitioner can monitor progress and improvement over the life of the project.

This diagnostic feature of the Framework is however, similar in principle to that developed as part of the Project Implementation Profile (PIP) presented by Pinto & Slevin [42]. The PIP model also uses a checklist to enable the project manager to assess the status of a project at given stages in its life cycle. Furthermore, the PIP project management tool has other similarities with the Framework for effective

collaboration management, in that it too is based on a number of "success" factors. The PIP model (Figure 8) shown below also describes the interrelationships between the factors in much the same way as the Framework model (Figure 9). However Pinto & Slevin's [42] model is based on factors critical to successful project implementation and as such is a generalised project management tool, as opposed to one which has been developed specifically for application in the context of collaboration management. As such therefore, it too excludes key collaboration success factors such as those associated with partner evaluation, project manager selection and academia-industry specific issues.

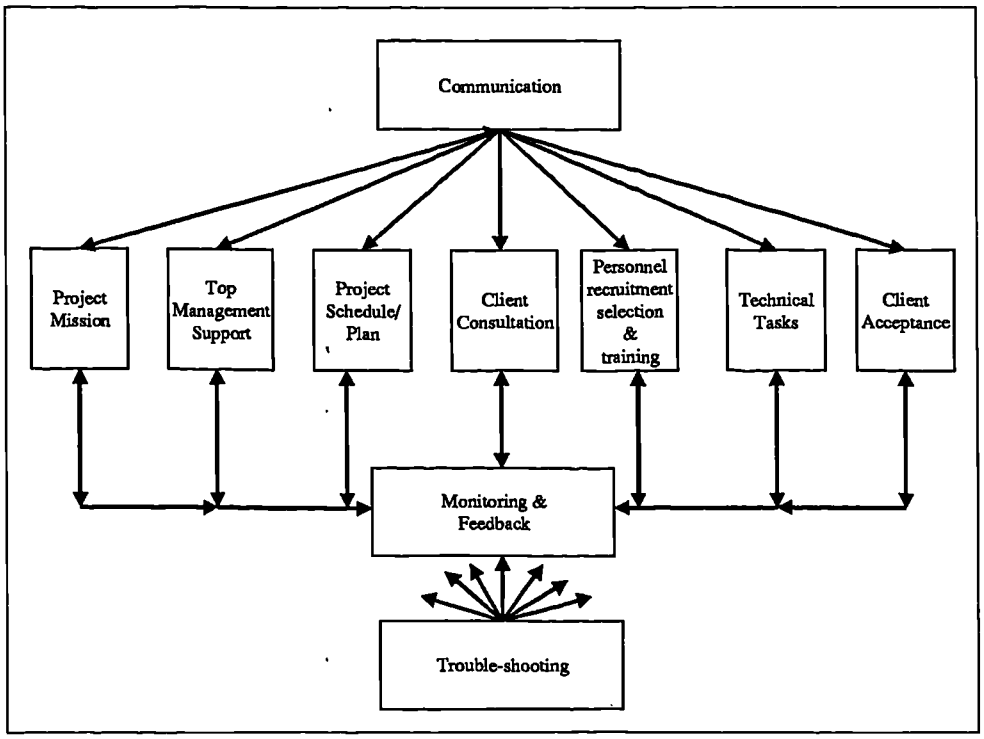

Figure 8 The Ten Factor Model of the Project Implementation Profile [42]

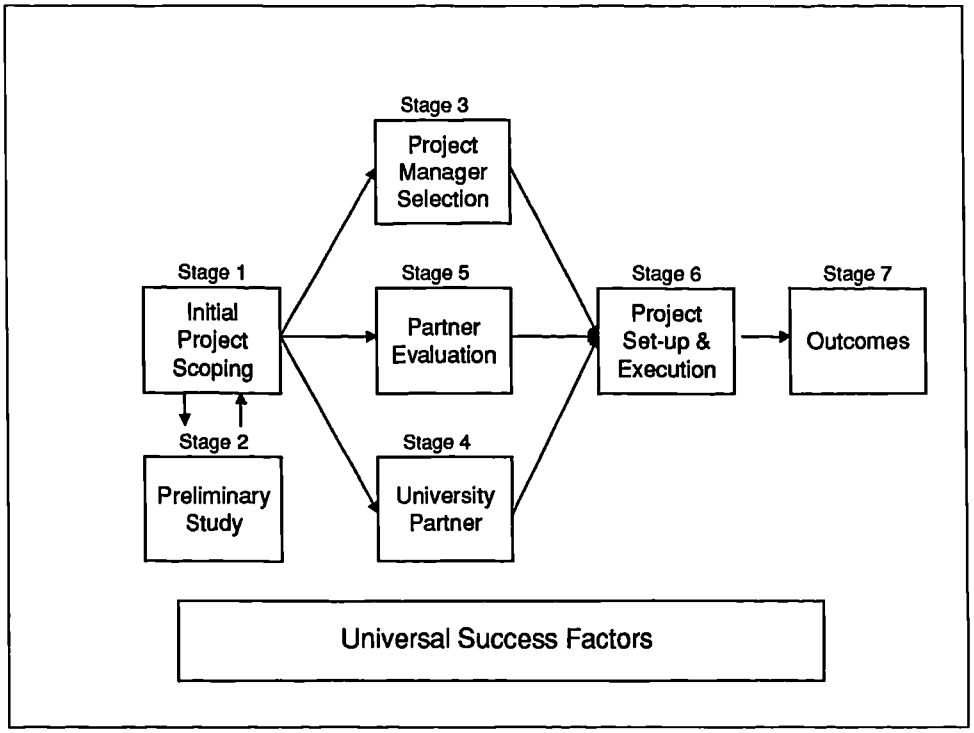

Figure 9 The Framework for Effective Management of Collaborative R&D Projects

It is therefore concluded that whilst similar approaches have been shown to exist in areas related to project management and software development, the absence of such a model in the context of collaboration management indicates that the Framework for effective management of collaborative R&D projects presented here, is novel and represents innovation in the application of the current body of knowledge, as established through research available in the public domain. However, while the concept is innovative, it is also important to establish that the Framework is usable as a management tool. Section 5 therefore briefly reports the results of initial implementation trials carried out involving the Framework.

5. Results of Preliminary Implementation Trials

Having developed the Framework, it was possible, prior to submission of the portfolio, to carry out a trial implementation of the *Framework Handbook* and *User Pack.* A collaborative research project due to commence from August 1999 was therefore identified as a means of achieving this. The project was selected on the basis that the collaboration involved partners from the automotive industry with WMG and one other university partner and therefore fitted well with the profile of the case study projects which informed the development of the Framework. Furthermore, the project was funded by IMI (Innovative Manufacturing Initiative), the same government initiative that funded a number of the other case study projects.

It is acknowledged that in order to fully validate the Framework, the implementation trial would require that the use of the Framework be monitored throughout the duration of the project, a process which would require a minimum of three years of study and assessment. Since this was not possible in the required timescale, the implementation trial concentrated only on those measures that could be accommodated under the circumstances, i.e. ease of use, ease of understanding and perceived usefulness. The Project Manager was central to this implementation exercise and provided feedback with respect to the above issues. A summary of the Project Manager's feedback regarding the *User Pack* and the *Handbook* is tabulated below, Table 4.

Table 4 Implementation Feedback

Criteria	Yes ✓ No ✖
Ease of use	✓
Ease of understanding	✓
Ease of interpretation of results	✓
Useful guidelines; aid to management process	✓

The Project Manager reported that he had had no difficulties with the use of the questionnaires, *Handbook* or charts or in understanding and interpreting the results. It was also stated that the *Handbook* was a useful source of reference information with regard to collaboration management. In general, the Project Manager indicated that the Framework would encourage effective project execution by providing an means of continuous monitoring. It was stated that the partitioning of the Collaboration Chart into "Low", "Moderate" and "High" risk zones in particular, would encourage on-going improvement through progressive re-evaluations of the project's status.

6. Applicability of the Framework

From the outset, the main focus of this research study has been to provide WMG and its industrial partners with a means of improving the effectiveness with which collaborative R&D projects are managed. This focus is clearly reflected in the choice exclusively of projects involving WMG as the subjects for case study investigation. Nevertheless, the results of this research indicate that the resulting Framework is more widely applicable.

In the first instance, evidence for this was provided by the extent to which the case study findings reflected those of the literature. The degree of commonality observed when influential factors identified in the case study research were compared directly with those incorporated in the best practice model for collaboration (Tables 2 and 3) suggested that the experiences of the case study project participants were not untypical.

Furthermore, at no point in the case study research were any issues raised which might be considered to constitute evidence for new, previously unidentified influencing factors. As such therefore, given the wide range of literature reviewed, spanning studies of a variety of different types of collaboration and different industrial sectors, the evidence indicates that the problems experienced by WMG and its partners were essentially generic, with a strong tendency to occur, to a greater or lesser extent, in any form of collaborative activity.

The arguments for the wider applicability of the results of this research are presented below. It is considered that the research findings and the resulting Framework are potentially applicable to a number of different related fields and as such, each aspect of the discussion is presented in separate sub-sections.

6.1 University-Industry Collaborations

It could be argued that WMG cannot be regarded as representative of a typical university department and therefore that the applicability of the Framework with respect to other universities will be limited. For example, the Group has a longstanding relationship with industry and many of its staff have considerable industrial experience. The Group also tends to work very closely with its industrial partners in its research activities, as opposed to the more traditional approach of attracting industry funding for research work which was then largely conducted by university researchers with little intervention by the sponsor companies. In addition, the Integrated Graduate Development Scheme (IGDS) Masters degree operated by WMG has enabled the Group to strengthen its links with participating companies. While other universities share some, if not all, of these characteristics, there will also be a number of universities that do not. Therefore, while such factors clearly favour success in collaborations with industry these characteristics also set the Group apart from some other university departments. Nevertheless, WMG can be regarded as having a number of features which are indisputably common with other university departments.

For example, WMG has an academic obligation to:

- Extend the frontiers of research in areas where the Group has established expertise
- Publish research work in academic journals, a key area in which academic performance is judged
- Provide students with relevant research projects which will add to the current body of knowledge and result in the attainment of degree qualifications
- Continuously improve and develop new teaching and training material in order to maintain the relevance of courses in the external environment

In these crucial respects therefore, the focus of this study on WMG and on collaborations in which WMG is a partner, is not considered to substantially compromise the wider applicability of the resulting Framework.

Furthermore, some of the more specific issues addressed by the Framework may also have some relevance beyond WMG. For example, the issues raised with respect to the role of student researchers in industry-orientated collaborative projects (Submission 5, Section 2.4). Though no specific cases of such problems occurring were offered by the literature, it is not unreasonable to assume that student researchers in other universities may have experienced similar difficulties. Similarly, the apparent importance of the Lead Researcher role in co-ordinating the research activities, could equally apply in collaborations involving other universities. Therefore, while there will inevitably be some areas in which the Framework is biased by the particular characteristics of WMG and collaborations in which the Group is involved, it is suspected that these will have little effect on the overall usefulness of the Framework beyond WMG.

In fact, it could be argued that a certain degree of tailoring of the Framework may be necessary with each new area of application since all collaborations will bring with them a particular set of circumstances and features which must be accommodated. The inclusion of all such slightly different permutations into the Framework would render it far too complex and unwieldy to be useful. Therefore, the Framework, as it stands, is considered to be a standardised process which currently also may include a number of features which tailor it to the needs of WMG and its industrial partners. Application of the Framework to other universities would be necessary to confirm the degree of tailoring required and how this could be done.

It is therefore concluded that, with regard to other university-industry collaborations, the evidence indicates that as a standardised process, the Framework is applicable beyond WMG. However, it is suspected that some degree of tailoring would be required in order for it to fully meet the needs of another university.

6.2 Industry-Industry Collaborations

In Section 2.1, which summarised the findings from the literature, it was stated that the best practice model for collaboration developed for this study, contained a number of success factors identified in studies involving industry-industry collaborations. Furthermore, some justification for the inclusion of these factors was provided by the finding that a number of success factors associated with collaboration management, were common to studies of both the industry-industry and university-industry contexts. This finding was further supported by evidence suggesting that some of these common factors influenced the success of the case study projects.

This indicates that a number of the factors critical to collaboration success are equally relevant in both industry-industry and university-industry collaboration activities. As such therefore, this indicates that the applicability of the Framework could be extended to purely industry-industry collaborations, by removing those aspects of it which are relevant only to university-industry collaborations, e.g. the *University Partner* element. However, while some of the success factors involved are essentially common to both circumstances, the guidance provided by the Framework, as it currently stands, is specifically biased toward university-industry collaborations.

For example, while the criteria for the selection of a Project Manager were influenced by the findings of research into industry-industry collaborations, some elements of the criteria are also designed to ensure that the Project Manager would be suited to collaborations involving academic research, e.g. previous experience of R&D projects. As such therefore, it is theoretically possible that the basic concept of the Framework could be applied to industry-industry collaborations. The Framework would however require more extensive modification for this purpose than for application to other university-industry collaborations.

6.3 Other Potential Areas of Application

Given that the Framework is designed to enable the user to:

- Make an assessment of the status of the project against best practice, and
- Measure performance semi-quantitatively,

two other potential areas of application may be considered for the future. Firstly, the use of the Framework provides the user with a permanent recorded history of the life of a collaboration which can be used in post-project analysis and review on

completion. The Framework therefore provides a template for project progress monitoring and post-project review which could be modified and applied to other types of project, e.g. new product development, thereby encouraging continuous learning and improvement.

Secondly, the manner in which the Framework assesses a project against best practice clearly indicates that it would lend itself to development into an evaluation tool for research proposals. The value of such a tool would be in enabling funding bodies to make a rapid and effective assessment of the likelihood of success or failure of a proposed collaborative project, on the basis of information provided regarding its set-up and project planning. This could also provide the basis for further work, subsequent to completion of this research.

7. Recommendations for Further Work

7.1 Further Testing and Implementation of the Framework

At the time of submission the Framework model and management tool had been subject to a limited amount of testing only. Further testing and validation of the Framework is therefore planned. This area of further work will include:

- Implementation of the questionnaires and charts in additional collaborative projects, in order to ensure ease of use and to further refine them
- Evaluation criteria will be developed as a means of assessing the performance of the Framework in improving the management of these collaborative projects
- The Framework currently gives equal weight to each element of the Framework model and the factors incorporated within them. The data generated by the implementation of the Framework in additional collaborations, will also be used to assess the benefits/impediments of applying differential weighting to these elements
- The criteria used to rate each element of the collaborative project as "High", "Moderate" or "Low Risk" (Collaboration Chart) will be refined through the collection of more data, as a result of further implementation
- The use of evaluation tools, e.g., "data mining" techniques, will be explored as a means of analysing the data collected from these additional collaborative projects. Such techniques could be used to evaluate and predict the influence of management success factors on the success of a collaboration

The further testing and implementation of the Framework will be primarily conducted through collaborative projects fitting the same criteria as were used to select the case study projects, i.e. projects involving WMG and the industrial sectors represented in WMG's research portfolio. This is necessary in order to avoid the unintended introduction of additional variables which could bias the implementation results. Plans

for the wider implementation of the Framework, beyond WMG are outlined in the next section.

7.2 Testing the Broader Applicability of the Framework

It is important to note that at the time of submission, the broader applicability of the Framework had yet to be tested. Both the case study projects and the project involved in the trial implementation of the Framework, involved WMG as the academic partner and industries which were well represented in WMG's research portfolio. The analysis of the case study data revealed a high degree of commonality between the case study results and the literature (Section 3.5), thereby indicating the broader *potential* applicability of the Framework model and management tool beyond WMG. This hypothesis however requires testing through further empirical work.

Further implementation of the Framework is therefore planned in the following areas:

- University-industry collaborations involving other universities as academic partners, in order to test the applicability of the Framework and to identify areas where "fine-tuning" may be required with each new subject
- Industry-industry collaborations involving industries other than those represented in the case study research. This work will identify differences in the relative influence of the management success factors, as well as areas for "fine-tuning", e.g., "cultural" factors associated with differences in mode of operation, organisational structure and management style
- International collaborations to identify those factors which the Framework would need to incorporate in order to address, for example, differences in national culture, social and legal infrastructure

7.3 Further Research and Application to New Areas

As has been previously stated in Section 6.3, the Framework could potentially be adapted for application by funding bodies as a tool for evaluating the likely success or failure of project proposals. Current LINK guidelines, for example, assess proposals on the basis of whether or not the participants meet the selection criteria, the potential for innovation and exploitation as conveyed by the stated project objectives, the degree of realism in the stated objectives, financial/resource considerations, preliminary project planning and management structure [43]. These are all important factors which are reflected in the Framework. However, while these criteria are designed to ensure that government money is being properly directed toward recipients and research interests that the government is seeking to help and encourage, it makes only a cursory assessment of the manner in which a project will be managed and the suitability, expertise and skills of the participants. It is however, these latter considerations which most strongly discriminate between collaborations which succeed and those which fail. Clearly, the ultimate test of efficient use of public money should be the number of successful projects and the degree of innovation obtained from collaborative activities. The Framework could readily be adapted for this purpose and offer funding bodies a means of testing project proposals, provide a "start-up" pack for collaborators as guidance, a simple-to-use method for on-going progress monitoring, and a post-project review mechanism which is far more detailed and informative than current methods [43]. Potential sources of funding to pursue research in this area have already been identified and will be applied for.

8. Conclusions

There is a growing trend toward collaboration between firms and between academia and industry. Studies have linked the use of external sources of information and expertise to the enhanced generation of innovation. Innovative firms, in turn, have been shown to out-perform non-innovating firms in terms of both growth and profit. Therefore, against a background of increasing international competition and rapid technological change, governments are actively encouraging collaboration as a means of improving innovation efficiency and thereby enhancing wealth creation. Collaboration provides companies with the means by which to advance technologically, at lower cost and with less inherent risk. Collaboration also provides access to a greater breadth and depth of knowledge and technologies than would normally be possible through internal development. For universities the benefits include additional public and private funding, and increasingly, licensing and patenting income, as a result of technology transfer activities.

However, these considerable potential benefits are often not realised in practice. The major reason is that collaborations between often diverse organisations, need considerable management effort in order to be successful. To this end, considerable research (reported in the literature) has been devoted to identifying management "success" factors, factors which where present, enhance the probability that a collaboration will be successful. This information was used by the author to develop a best practice model for collaboration management that is more comprehensive than has previously been reported in the literature. However, while research into collaboration is available in the public domain for the collaboration practitioner to learn from, no guidance is given as to how the full range of these success factors could be applied in

the every day context of managing a collaboration. Furthermore, the development of the best practice model illustrated the fact that highly relevant research is available from disparate sources of literature, covering a number of research fields, e.g., university-industry collaborations, industry-industry collaborations (including strategic alliances, research consortia and joint ventures), project management, project implementation and new product development.

A need was therefore identified for a means of bringing together the disparate threads of relevant research and presenting it in a way which does not require the user to be an experienced collaboration practitioner or to be conversant with the current body of knowledge. The Framework presented here provides a mechanism for achieving this in the form of a simple-to-apply management tool. The Framework is designed to provide the collaboration practitioner or project manager with an awareness of the key issues affecting the success of collaborations and to prompt the manager to take appropriate and timely action to prevent the occurrence of problems later on. The Framework will provide WMG and its industrial partners with a means of improving the effectiveness of collaboration management, thereby enhancing the probability that the *potential* benefits of collaboration will become *actual* benefits. The concept of a management tool or Framework that enhances management effectiveness in this way is new to the collaboration field and as such it constitutes the main innovation to result from this research.

Furthermore, while the Framework was originally conceived as a specific aid to collaboration between WMG and its industrial partners, evidence gathered throughout this research indicates that it is much more widely applicable. A high degree of commonality between the case study research findings and the literature indicates that the Framework is certainly applicable, with some tailoring, to other university-industry collaborations. Furthermore, the existence of a number of success factors common to both industry-industry and university-industry collaborations, indicates that the Framework could also be applied to collaborations which do not involve a university, though a greater degree of modification would be required.

Finally, the manner in which the Framework assesses a project against best practice indicates that it would lend itself to development into an evaluation tool for research proposals. The value of such a tool would be in enabling funding bodies to make a rapid and effective assessment of the likelihood of success or failure of a proposed collaborative project, on the basis of information provided regarding its set-up and project planning. The potential value of the Framework therefore extends beyond industry and academia, to ensuring the efficient use of public funds.

However, while the Framework concept and the success factors on which it is based are considered robust, having been validated through the literature and the case study findings, the criteria against which performance is measured (through the questionnaires and charts) can be regarded only as a rough guide at this stage. The criteria were established with careful attention to the findings of both the literature and the case study research, but since the literature revealed no evidence of similar attempts at measuring performance in this way, it was not possible to validate the criteria by reference to other, similar research.

With respect to the aims of this research work, the lack of certainty regarding the measurement criteria is not considered detrimental since, for the purposes of demonstrating innovation in the application of the current body of knowledge, it is the concept of the Framework which is important. This research study therefore constitutes the first stage in what will be an on-going research process. Further research will build on this innovation, refining it and developing it further in order that its potential in terms of its wider applicability can be fulfilled. The main achievements of this research are summarised as follows:

- The development of a best practice model for collaboration management which is more comprehensive than has previously been reported in the literature
- A comprehensive evaluation of collaborations involving WMG was carried out as part of this work and the results and main learning points will be disseminated to WMG staff and partner companies
- The assimilation of disparate sources of information, research and knowledge into a simple-to-apply management tool – a Framework, which guides the collaboration practitioner through the process of setting-up and running a collaborative research project, and in so doing will improve the probability that a collaboration will be successful. The Framework does not assume prior experience, expertise or familiarity with the current body of knowledge on the part of the user.
- It has been shown that the Framework is capable of wider application, in the first instance to university-industry collaborations generally, and with some modification to industry-industry collaborations and as a mechanism for evaluating project funding proposals by funding bodies

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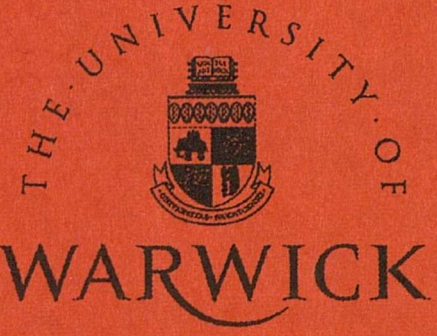
Appendix A

Framework Management Tool



A Handbook for

Effective Management of Collaborative R&D Projects

by Tina Barnes

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Part I

A Guide to the Use of the Framework

1. Introduction

This Handbook is intended to provide guidance to the user in applying a Framework for the effective management of collaborative R&D projects.

In an environment of rapid technological change and increasingly sophisticated technology, technological collaboration offers companies a viable alternative to developing the required competencies in-house. Collaboration has been shown to increase the generation of innovation - the best innovators are those who make effective use of external sources of know-how and technology, i.e. sources outside of the organisation. Furthermore, there is strong evidence to suggest that innovating firms consistently out-perform non-innovating firms in terms of growth and profit [1]. Collaboration also offers the opportunity (in theory) to share the cost and risks associated with technological development and to reduce development time.

1.1 Why the Framework is Needed

Despite the potential values of collaboration many such ventures fail to realise their full potential. The reason for this is simply that collaborations are, by nature, difficult to manage. Partners invariably enter into a collaboration with different objectives in mind, different priorities and different preferred ways of doing things. Reconciling these differences and resolving many other management issues associated with collaboration, is no simple task. There is a need therefore for a management process which, if systematically applied, will enhance the probability that a collaboration will succeed.

Research in this area suggests that a number of management success factors exist which when present in a collaboration, tend to increase the probability that it will succeed. However, as of yet, no practical method of applying these success factors exists to aid the collaboration practitioner. The Framework described in this Handbook seeks to provide that practical method. The Framework draws together relevant knowledge from a number of fields, i.e., innovation, technology management, new product development, project management and studies of university-industry and industry-industry collaborations, and presents it in a coherent, usable form. The management success factors that provide the basic structure of the Framework, were identified through a study of best practice in the management of collaborations which covered a broad range of types of collaboration and industry sectors. As such therefore, the Framework incorporates in it, the current body of knowledge regarding collaborative best practice and provides a process of project management which is tailored specifically to the needs of university-industry research collaborations. Therefore, by applying a series of questionnaires, the collaboration practitioner is gaining access to the

current body of knowledge and is guided through the process of setting-up and running an effective collaborative R&D project.

The Framework therefore fills the gap between a wide and disparate array of published research and the collaboration practitioner. The Framework is a tool that allows the collaboration practitioner to apply best practice and the results of published research in a systematic manner. Furthermore, the collaboration practitioner does not need to be aware of the current body of knowledge or have prior expertise in the field of collaboration management. The Framework therefore fulfils a recognised need for a systematic management process that can be applied by a non-expert collaboration practitioner and will enhance the probability that a collaboration will succeed.

1.2 Where the Framework can be Applied

The Framework is specifically designed for application to collaborative *R&D projects*. It also assumes the presence of partners from *academia* as well as *industry*. The management success factors on which the Framework is based are essentially generic (applying equally to all types of collaboration and across industrial sectors). In principal, this means that the Framework could be applied to any form of collaboration. However, the Framework contains additional features that tailor it specifically to the needs of collaboration practitioners engaged in collaborative R&D projects involving academic and industrial partners. Such tailoring is necessary to maximise the benefits that can be leveraged from its use. It is recommended therefore, that the Framework should be applied only in the context of *university-industry research collaborations*. Its use in any other context would require that modifications be made to the Framework in order to tailor it to the specific needs of each new application area.

1.3 Who should Apply it

The Framework has been designed predominantly for use by the collaboration manager or "Project Manager" as the role is termed throughout the Handbook. Therefore, the Handbook is written with the Project Manager in mind and the questionnaires contained in the *User Pack* will be administered, for the most part, by the Project Manager. However, recognising that the Project Manager role is itself critical to the success of a collaborative project, the Framework also provides guidelines for the selection of an appropriate candidate. These guidelines are therefore designed specifically to aid those with responsibility for assigning personnel to this key role.

1.4 The Basic Structure of the Framework

The basic Framework model is presented below, Figure 1.

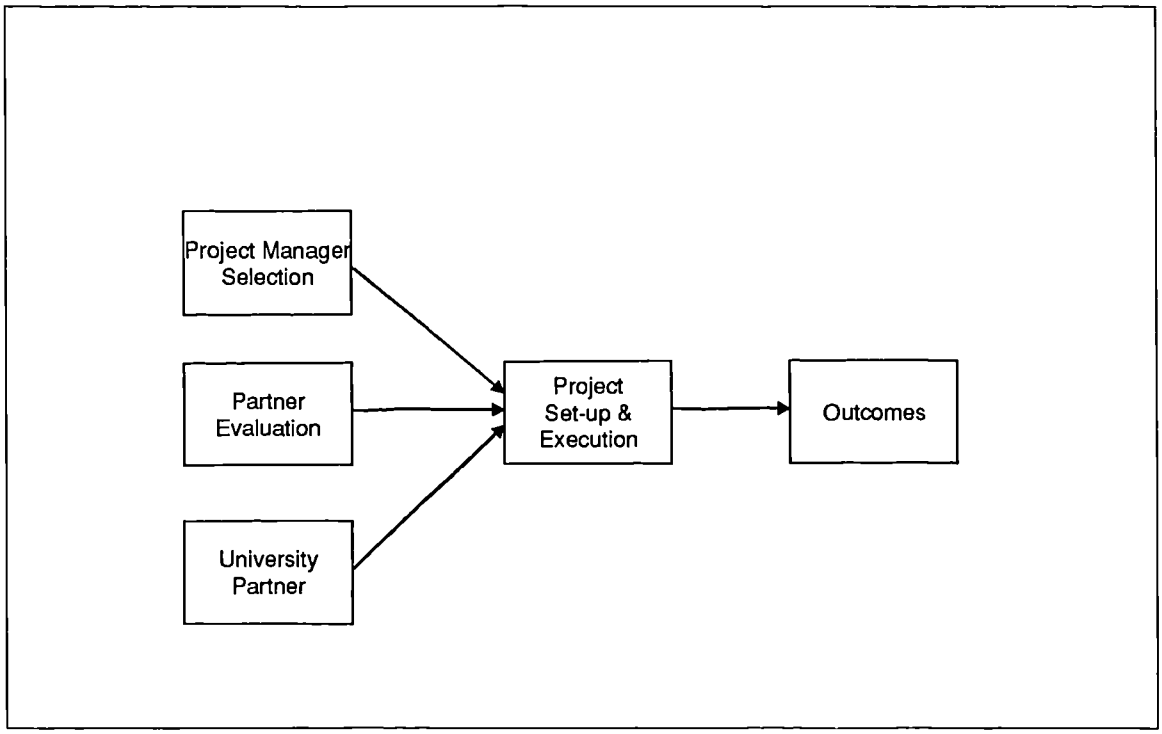


Figure 1 Basic Model of the Framework for Effective Management of R&D Projects

Each element of the model constitutes a major stage of the management process. The importance of *Project Manager* and *Partner Evaluation* are emphasised, along with the need to clearly define the role of any *University Partners* who may be involved.

There is considerable evidence available to suggest that appropriately skilled, experienced, high quality project managers are essential to collaboration success. The evaluation of appropriate collaboration partners is similarly well supported by published research as a critical feature in the success of collaborations. The *University Partner* element of the Framework is concerned, not with selecting appropriate partners but with resolving a number of important project management issues associated with the university partner. Research has indicated that in certain key areas of the management of collaborative research projects, the university partner has a substantial impact on effectiveness. These are the issues that the *University Partner* element of the Framework is designed to address.

It should be noted that the Framework is designed specifically for application in university-industry research collaborations and as such it incorporates, throughout its structure, features which are designed specifically to address the particular difficulties associated with university-industry collaborations, i.e., the impacts of the academia-industry "cultural gap". As such therefore, the treatment of issues related to academic-industry partnerships is integral to the design of the Framework throughout and is not merely limited to the *University Partner* element.

The *Project Set-up and Execution* stage is designed to ensure that all issues pertaining to effective project set-up and management are addressed, since research has indicated that project management can have a substantial impact on effectiveness and collaboration success. The *Outcomes* stage is designed partly as a performance measurement stage, providing the user with a means of establishing the outcomes/benefits to result from a project. Practitioners are made aware of a range of potentially valuable outcomes ranging from tangible benefits such as the development of a new technology or IPR, to less immediately quantifiable benefits such as the identification of new directions for future investigation and opportunities for further collaboration. However, while performance measurement at the end of a collaboration is important, it is equally important that the required or desired outcomes be identified early on in the project and that progress toward the achievement of these outcomes is monitored throughout its duration. Therefore, the Framework incorporates features which encourage the implementation of this kind of target setting and progress monitoring. Such features if properly implemented ensure that *mutual benefit* is achieved among collaborating partners and increases the likelihood that each partner will realise satisfactory *proprietary benefit* from their involvement. Such measures also encourage interest and commitment among collaborative partners.

However, as a project management process, the Framework requires two additional stages to precede the collaboration process, in order to be considered complete. These additional stages are *Initial Project Scoping* and *Preliminary Study*.

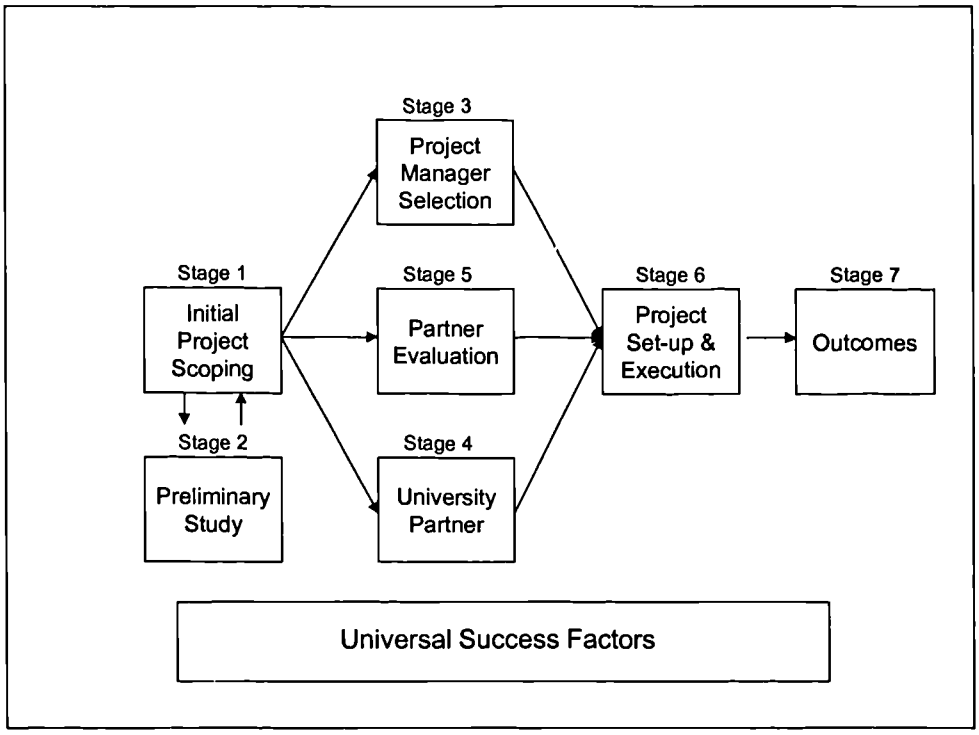


Figure 2 Complete Project Management Process Model for Effective Collaboration Management

The rationale behind the *Initial Project Scoping* stage is that the project initiators will need to have some idea of the project's scope and objectives before involving collaboration partners. It would also be advisable to consider how the project would achieve those objectives. The *Preliminary Study* stage recognises that there may be a need for some preliminary work prior to the collaborative project itself. For example, where there are a number of potential technological solutions to a given problem, it may be advisable to establish the technological and commercial risks inherent in each potential solution, as a means of reducing the scope of the project to a smaller number of viable options which can be researched in detail.

Figure 2 also includes one other additional element, the *Universal Success Factors*. These factors, though shown by research to be important to collaboration success, tend not to be easy to categorise, being for the most part relevant throughout the project management process. For this reason the *Universal Success Factors* are shown as a discrete element spanning the length of the project management process. This Handbook provides a guide to these factors and their role in collaboration success.

Figure 2 therefore represents the overall structure of the Framework. Each element of the Framework incorporates a further level of detail and a number of associated success factors. This detail constitutes the basis for a series of questionnaires which are designed to guide collaboration practitioners through the process of setting-up and managing an effective collaborative R&D project.

The major issues associated with each stage of the management process are dealt with through these questionnaires:

Q-1 Project Manager Selection Questionnaire
Q-2 University Partner Questionnaire
Q-3 Partner Evaluation Questionnaire
Q-4 Project Outputs Questionnaire
Q-5 Project Set-up & Execution Questionnaire
Q-6 Outcomes Questionnaire

The questionnaires are designed to alert the user to the existence of potential problems and to prompt the Project Manager (and other key personnel) to ***take action in time to prevent problems later on in the project***. The Framework is applied simply by filling in the relevant questionnaires as each stage of the process is reached. Each questionnaire incorporates a scoring system which enables the user to evaluate progress by plotting the results on a *Collaboration Chart*. The *Collaboration Chart* provides a visual representation of the status of a collaboration which is easier for the user to interpret. An example of the *Collaboration Chart* is shown below, Figure 3.

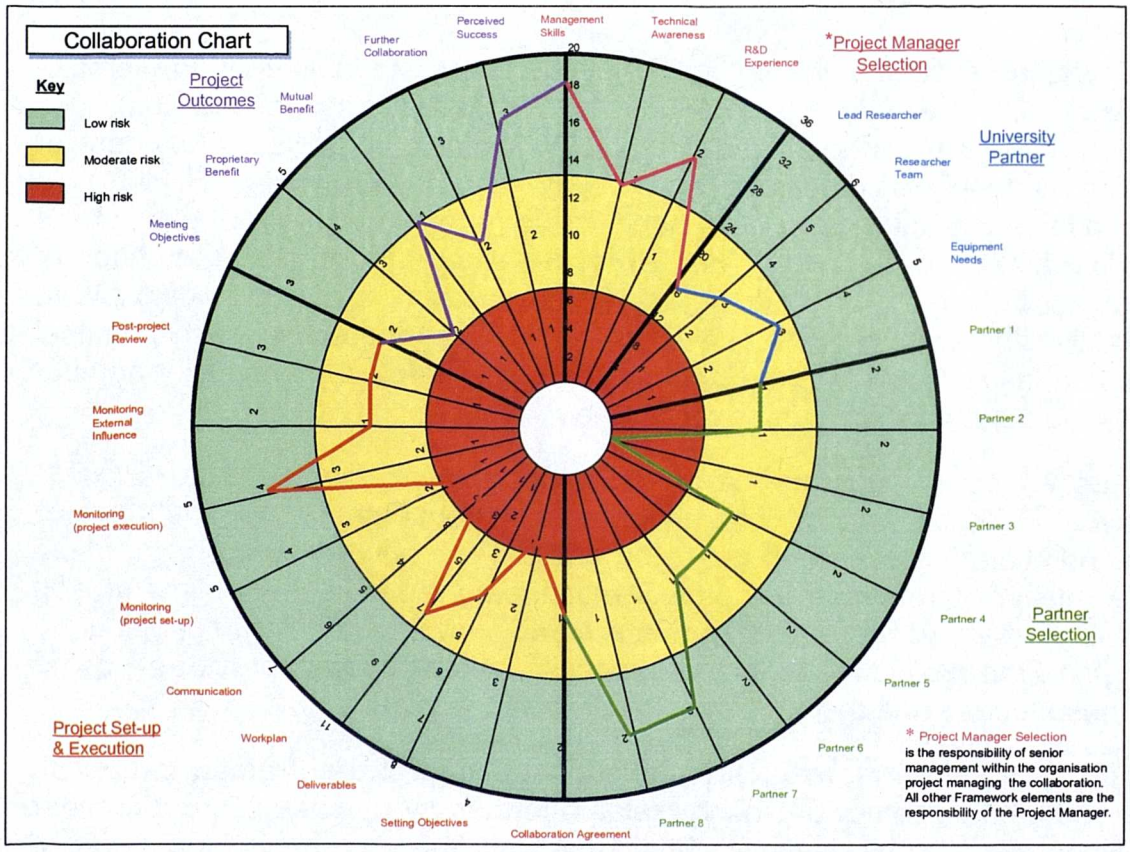


Figure 3 Example of a Collaboration Chart

1.5 Interpreting the Results

By plotting the results on a *Collaboration Chart*, potential "high risk" problem areas become immediately apparent. However, care must be taken in interpreting the results. ***The differing circumstances of each individual collaboration means that the relative importance of certain factors will vary from project to project.*** It is essential therefore, that the user determine how critical each potential area of weakness is likely to be to the ultimate success of the project. For example, in a collaboration where the partners' roles are predominantly passive, providing funding and materials only, for example, the fact that some of them have no previous experience of collaboration is unlikely to be severely detrimental to the project's success.

The Framework is not therefore designed to be prescriptive. It merely provides a guide and prompts the user to consider the results in light of the particular circumstances of a given collaboration and to make a judgement as to the relative importance of the issues in that case.

Finally, the Framework has been designed in such a way as to aid the Project Manager in the post-project review stage. The *Collaboration Chart* provides a record of the collaboration which the Project Manager can use in assessing what has been learned and may provide an indication of where improvements could be made for subsequent projects.

1.6 How to Use this Handbook

Section 2 of this Handbook provides instructions as to the application of the questionnaires and how to record the results on the *Collaboration Chart*. ***The user is therefore advised to read this section carefully before proceeding.***

Part II of the Handbook contains the *Guide Notes*. The *Guide Notes* provide the user with background information and an explanation of the issues addressed through the Framework. As such therefore, *Part II* is designed for reference purposes. Where appropriate, the questionnaires include references to relevant sections of the *Guide Notes* to help the user locate the information required.

1.7 References

[1] Geroski, P. & Machin, S., Do Innovating Firms Outperform Non-Innovators?, *Business Strategy Review*, Summer, 1992, p79-90.

2. How to Use the Framework

2.1 The User Pack

The *User Pack* accompanying this Handbook should contain:

Q-1 Project Manager Selection Questionnaire
Q-2 University Partner Questionnaire
Q-3 Partner Evaluation Questionnaire
Q-4 Project Outputs Questionnaire
Q-5 Project Set-up & Execution Questionnaire
Q-6 Outcomes Questionnaire

Partner Evaluation Charts
Collaboration Chart

2.2 Applying the Questionnaires

This section provides guidance on the use of the *User Pack* Questionnaires. In certain cases, e.g., the Partner Evaluation Questionnaire (Q-3) and the Project Outputs Questionnaire (Q-4), there is also guidance as to how to interpret the responses given by collaborators and how this information should be used.

2.2.1 Project Manager Selection Questionnaire

This questionnaire (Q-1) is designed for use by personnel with the responsibility of selecting a candidate for the role of Project Manager in a collaborative R&D project. This element of the Framework recognises that certain management skills, experience and training are essential to the successful fulfilment of this key role.

The prospective Project Manager is measured on three major parameters - "management skills", "technical awareness", and "R&D experience". Responses to each question in questionnaire Q-1 are scored, and the user is asked to add these scores together at the end of each Section in order to arrive at a total score for each parameter. The user is then asked to plot the score for each parameter on the *Collaboration Chart* - the relevant axis on which to plot each parameter is clear labelled.

Important note: *Collaborations are difficult to manage and require the highest quality project managers to run them effectively. (See Guide notes, Section 3)*

2.2.2 University Partners Questionnaire

This questionnaire (Q-2) follows the same logic as Q-1 in that the university partner(s) is evaluated on three major parameters - "lead researcher", "researcher team" and "equipment needs". Again, responses to each question are individually scored and the user is asked to add these scores together at the end of each Section in order to arrive at a total score for each parameter. The user is then asked to plot the score for each parameter on the *Collaboration Chart.*

Questionnaire Q-2 should be applied by the Project Manager, with the co-operation of senior staff from the department of the university involved in the project. It will generally be the case that the university partner will have been involved in the project from its inception and as such the questionnaire is not aimed at *selecting* a university partner. Furthermore, if this is the case, the Lead Researcher will already have been instrumental in developing the project idea and the initial project plan. Therefore, it is unlikely that the questionnaire will be used to *select* a Lead Researcher.

What the Framework will do in such circumstances however, is to highlight the key role that the Lead Researcher and the Researcher Team have within a collaborative research programme. Through the questionnaire, the Framework aims to encourage universities to ensure that collaborative projects are served by appropriately experienced personnel and that those personnel are fully aware of their responsibilities to the project.

Therefore, where it is established that, for example, the Lead Researcher does not have any industrial experience, the university partner is encouraged to address the issue. In some cases, it may be possible to compensate by selecting or recruiting researchers who do have some industrial experience. Alternatively, the Lead Researcher could make a particular effort to gain an awareness of the industrial issues regarding the project and the intended research.

> ***Important note:*** *The Lead Researcher has a critical role to play in managing the university's role in the project (See Guide notes, Section 4.2)*

2.2.3 Partner Evaluation Questionnaire

The Partner Evaluation Questionnaire (Q-3) is designed to aid the Project Manager in assessing the level of risk associated with each of the partners supporting the project. For example, partners currently undergoing re-organisation or some other form of corporate instability tend to be distracted by such internal changes and can therefore prove unreliable. In identifying these risk factors the Project Manager is therefore afforded the opportunity for risk mitigation. Copies of the questionnaire (Q-3) should be given to each partner to fill-in. The information provided by the partners can then be analysed by the Project Manager.

However, prior to beginning the partner evaluation process, the user is advised to refer to the Checklist below to ensure that essential project planning stages have been completed. Reference to Sections 1 and 2 of the *Guide Notes* which address the issues associated with *Initial Project Scoping* and the *Preliminary Study* may also be useful. If the steps outlined below have not been completed then it is suggested that the Project Manager does **not** have sufficient information available to make an accurate assessment of the partners.

Important Note: *Therefore, the Project Manager is strongly advised not to proceed until these project planning stages have been completed:*

2.2.3.1 Partner Evaluation Pre-check List

1. Have the full range of areas of expertise required for the project been clearly identified?

2. Have the individual roles and responsibilities that each partner will be expected to undertake within the project, been identified and clearly defined?

3. Is a draft copy of the Collaboration Agreement available for potential partners to consider?

4. Consider what type of support will be required of each project partner. The type of support required can be categorised into four specific types:

   Resource support - cash contributions, equipment, materials

   Technical support - *resource support* + technical support as required

   Development support - *resource* &/or *technical support* and an active role in the development work

   Research support - *resource* &/or *technical support* and an active role in the research work

5. Has your organisation worked with any of the partners before? If so, consider whether that partner could be classed as a "good" or a "bad" collaborator. Note that additional information may be available from other areas of your organisation and it is therefore important not to limit the search to specific departments or areas of the business. Attributes to take into account in this assessment include the organisation's enthusiasm, attendance at progress meetings, contribution to discussion and to the work, and whether or not the organisation met its commitments in full and in reasonable time.

   If possible, use this assessment to avoid collaboration with "poor" partners.

> ***Important note:*** *Be aware that negative opinions regarding specific partners can be formed for a number of reasons. Consider the circumstances of any previous partnerships very carefully.*

questionnaire Q-3. Below are instructions to help the Project Manager evaluate the responses given.

2.2.3.1 Partner Evaluator Guide

This guide provides question-by-question instructions for the evaluation of responses to questionnaire Q-3. The questions are designed in such a way as to facilitate the plotting of the responses onto a *Partner Evaluation Chart*, Figure 4.

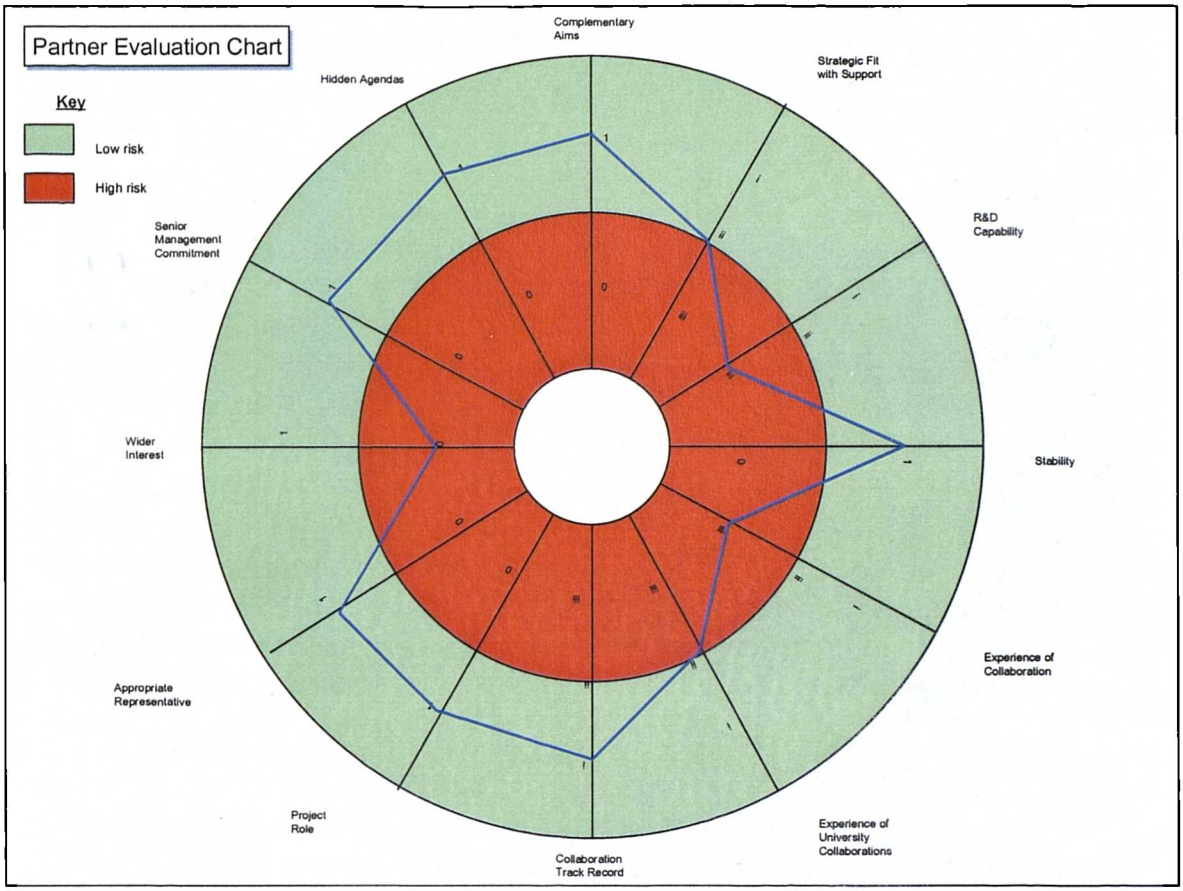


Figure 4 Example of a Partner Evaluation Chart

Follow the instructions below and plot the results accordingly on the Chart. A separate chart should be plotted for each partner. The numbering of these instructions correspond to the individual question numbers on the Questionnaire.

1. Are the partner's objectives complementary to those defined for the project in *Stage 1 (Initial Project Scoping)*? (*See Guide Notes, Section 4.3.4).* If the partner's objectives are complementary plot "1" on the Chart on the axis marked "complementary aims". Otherwise, plot "0" on the Chart.

2. The prefixes i, ii and iii correspond to positions on the Chart. Plot the partner's response accordingly on the axis marked "strategic importance". (*See Guide Notes, Section 4.3.2).*

3. The prefixes i, ii and iii correspond to positions on the Chart. Plot the partner's response accordingly on the axis marked "R&D capability". Note that a lack of R&D background need not be detrimental to the project. For example, if *Technical or Resource Support* only are required an R&D background is less likely to be relevant. If *Research* or *Development Support* is required, an R&D background would however, be desirable (*See Guide Notes, Section 4.3.9)*

4. If the partner indicates that the company has recently undergone any of the changes suggested, plot "0" on the Chart, on the axis marked "stability". If the company has not under-gone any significant changes in the recent past, plot "1" on the Chart. (*See Guide Notes, Section 4.3.6).*

5. The prefixes i, ii and iii correspond to positions on the Chart. Plot the partner's response accordingly on the axis marked "experience of collaboration".

6. The prefixes i, ii and iii correspond to positions on the Chart. Plot the partner's response accordingly on the axis marked "experience of university collaborations".

7. For partners with whom your organisation has not previously worked, if approval has been given by the potential partner, contact the organisations listed for their views on the success or failure of the project, and on the potential partner's contribution to it. With regard to the partner's collaboration track record, ask each contact to rate the partner as either "good", "satisfactory" or "bad". Select the appropriate option

below and use the prefix i, ii or iii to plot the result on the Chart, on the axis marked "collaboration track record". (*See Guide Notes, Section 4.3.8).*

i. Rated a "good" collaborator by most previous partners contacted
ii. Rated a "satisfactory" collaborator by most previous partners contacted
iii. Rated a "bad" collaborator by most previous partners contacted

8.& 9. If the partner's response to these questions fit well with the intended role within the project, plot "1" on the Chart, on the axis marked "project role". Otherwise, plot "0" on the Chart.

10. Responses to this question should provide an early opportunity to ensure that the intended representative will be appropriate to the role assigned to each partner. The prefixes i and ii correspond to positions on the Chart, on the axis marked "appropriate representative".

i. Appropriate representative identified
ii. Representative identified is inappropriate

WARNING *- Concern should be raised if a partner intended to be engaged in a technical aspect of the project suggests that a sales person represent the organisation. This may indicate a purely commercial interest in the project and a lack of interest in the actual research work to be carried out.*

11. This information should be used to set-up a network of dissemination channels into the partner organisations. Wider dissemination of information will raise the profile of the project within the partner organisations and should thereby increase commitment to the project. The prefixes i and ii correspond to positions on the Chart, on the axis marked "wider interest".

i. Wider interest indicated
ii. No interest beyond the current contact indicated

12. Collaboration partners who are committed to the intended research are critical to the success of a collaboration. Senior management commitment is a particularly important factor since without it lower levels of management are unlikely to afford the project the required degree of attention and priority. Reluctance on the part of a partner's senior management team to become involved in overseeing the project may

indicate that the company concerned is not sufficiently committed to the venture. Such reticence should therefore be treated with caution. If senior management interest is indicated plot "1" on the Chart, on the axis marked "senior management commitment". Otherwise plot "0" on the Chart. *(See Guide Notes, Section 4.3.5)*

13. Consider all of the information provided by the partner so far, through the *Partner Evaluation Questionnaire* and preliminary discussions. Based on this information, is there any evidence of a hidden agenda?, i.e., is there any indication that the partner's interest in the venture is motivated by objectives that are not complementary to the project as a whole? Are the objectives of partners likely to be achieved only at the expense of the other partners involved, or are they likely to jeopardise the success of the project in some way? *(See Guide Notes, Section 4.3.3)*

    Note that if a hidden agenda exists which is unlikely to have a negative impact on the project, or could even have some positive spin-off benefits, no action is required. However, hidden agenda can have substantial negative impacts and action must therefore be taken where it is suspected that this will be the case.

    If it is suspected that the partner may have a hidden agenda which is likely to have a *detrimental effect* on the collaboration, plot "0" on the Chart, on the axis marked "hidden agendas". If no such suspicion exists then plot "1" on the Chart.

Interpreting the Results of the Partner Evaluation Charts

Having plotted a *Partner Evaluation Chart* for each partner, the Project Manager should be in a position to make an assessment of the risks presented by each partner. Partners presenting the lowest level of risk to the success of the collaboration will have the greatest number of points lying in the white outer band of the Chart. Partners with a significant number of points lying inside the grey inner band of the Chart should be considered a possible cause for concern.

It must be stressed that the partner profiles, as plotted on the Chart, should be interpreted in light of the particular circumstances of the project. Therefore, if it is considered unimportant that a partner should have previous experience of collaboration in the context of a given project, this element of the profile can be ignored. Similarly, a partner shown to be "high-risk" with respect to one parameter, may not be considered a "high risk" overall if all other parameters fall within the "low risk" band. In such cases, the project manager is however advised to monitor that partner's performance with respect to the "high risk" elements of their profile and to take appropriate action to minimise potential problems in this respect.

Transferring the Results to the Collaboration Chart

When the partners have been evaluated, their profiles need to be represented on the *Collaboration Chart*. To do this, compare the profile on the *Partner Evaluation Chart* with the criteria below. For example, if the scores on the *Partner Evaluation Chart* lie mostly in the green *outer* band, the partner concerned will score 2 on the *Collaboration Chart* as per the criteria:

Mostly in the green *outer band* of the *Partner Chart*	**(2)**
Mostly in the *outer band* **and** on the *borderline*	**(1)**
Mostly in the red *inner band* of the Partner Chart	**(0)**

The result with regard to the *Collaboration Chart* will clearly be a very coarse indicator of partner status. However, where more detail is necessary the Project Manager can refer back to the *Partner Evaluation Charts* which should be retained as a record for subsequent reference. Partners achieving scores lying mostly in the green outer band represent the lowest risk and should therefore be afforded a higher priority in evaluating partners.

2.2.4 Project Output Questionnaire

The *Project Output Questionnaire* (Q-4) is designed to obtain information from project partners with regard to the relative importance of planned project outputs. Expected project outputs will have been identified as part of the initial project planning (*Stage 1 – Initial Project Scoping*). However, in bringing a number of additional partners into the project, it is essential to gain their views as to which outputs are considered most critical and to identify any other outputs which partners believe to be important. At the same time, the partners are asked to indicate which outputs are most urgent and should therefore be delivered first. This information should be used in subsequent discussion to clarify and achieve consensus regarding project outputs. The results can then be integrated into the project plan.

In addition, Q-4 provides the Project Manager with information regarding the form in which partners would like to receive research results and general communications regarding project progress. Copies of Q-4 should be distributed to partner representatives on the Project Team and any other parties with an interest in the project from within the partner organisations. Responses to Q-4 questionnaires are not scored or plotted on the *Collaboration Chart*. They are for the Project Manager's benefit only, to aid in the project planning process. Q-4 questionnaires can be used at any point after the project partners join the project, as part of the process of *Project Set-up & Execution.*

Note: *The Project Outputs Questionnaire is based on the work of M. Hobday & H. Rush regarding User Needs Analysis, reported in Industry & Higher Education, April, 1997, p96-100.*

2.2.5 Project Set-up & Execution Questionnaire

The *Project Set-up & Execution Questionnaire* (Q-5) is, in effect, a checklist that the Project Manager can fill-in progressively over the duration of the project. The purpose of the questionnaire is to help the Project Manager to, as far as possible, create conditions within the project that are conducive to collaboration success. As such therefore, the questionnaire consists almost entirely of questions requiring only a "Yes" or "No" response. However, in order to provide a means of monitoring progress, Q-5 also asks the user to plot the total number of "Yes" responses against each of eight major parameters – "collaboration agreement, "setting clear objectives", "deliverables", "workplan", "communication", "project monitoring", "monitoring external influence" and "post-project review". The Project Manager should therefore work progressively toward achieving scores in the outer band of the *Collaboration Chart* for each of these eight parameters.

2.2.6 Outcomes Questionnaire

The *Outcomes Questionnaire* (Q-6) is designed to fulfil two main purposes - to measure project success, as perceived by the partners, and as a means of prompting collaborators to recognise the value of a range of project outputs. ***The questionnaire can and should be used to monitor partners views as to the value of the collaboration throughout its duration, and not merely as a post-project measure.*** Used periodically throughout the project, Q-6 can provide the Project Manager with an early warning if the project is not meeting partners' expectations.

Conversely, significant project achievements will also be highlighted through application of Q-6 and the Project Manager is advised to report such findings back to the Project Team as a whole and to the Steering Committee and other interested parties, as a means of reinforcing interest and commitment to the work. Instructions regarding the analysis of partners' responses to Q-6 and how to plot the findings on the *Collaboration Chart* is provided in the *Outcomes Evaluation Guide* below.

Outcomes Evaluation Guide

This guide provides question-by-question instructions as to the analysis of partners' responses to the *Outcomes Questionnaire* (Q-6):

1. Examine the responses of all the project's partners to Question 1. Select the option which best describes the data and plot the appropriate score on to the *Collaboration Chart,* on the axis marked "meeting objectives".

Mostly I.	(3)
Mostly II.	(2)
Mostly III.	(1)
Mostly IV.	(0)

2. Calculate an average score from responses to Question 2 and plot the result on the *Collaboration Chart,* on the axis marked "proprietary benefit".

3. What benefits have emerged from the project so far? Refer to the responses to Question 3 of the *Outcomes Questionnaire.* Compile a list and communicate the results to the Project Team and the Steering Committee. (*See Guide Notes, Section 7.2)*

4. Consider any views expressed in response to Question 4 and initiate further discussion of the issues with the partners concerned, with a view to taking action to improve the situation. (*See Guide Notes, Section 7.2)*

5. Examine the responses of all the project's partners to Question 5. Select the option which best describes the data and plot the appropriate score on the *Collaboration Chart,* on the axis marked "mutual benefit".

Mostly I.	(2)
Mostly III.	(0)

6. Compile a list of "unexpected" benefits and communicate the results to the Project Team and the Steering Committee.

7. Summarise partners' responses to Question 7 and communicate the results to the Project Team and the Steering Committee.

8. Examine the responses of all the project's partners to Question 8. Select the option which best describes the data and plot the appropriate score on the *Collaboration Chart,* on the axis marked "further collaboration". (*See Guide Notes, Section 7.6)*

Mostly I.	(3)
Mostly II.	(2)
Mostly III.	(1)
Mostly IV.	(0)

9. Examine the responses of all the project's partners to Question 9. Select the option which best describes the data and plot the appropriate score on the *Collaboration Chart,* on the axis marked "perceived success".

Mostly I.	(3)
Mostly II.	(2)
Mostly III.	(1)
Mostly IV.	(0)

10. Compile a list of any new lines of investigation identified in Question 10 and communicate the results to the Project Team and the Steering Committee. *(See Guide Notes, Section 7.6).*

11. Consider any views expressed in response to Question 11 and initiate further discussion of the issues with the partners concerned, with a view to taking action to improve the situation.

Appraising Project Outputs

Aside from establishing the level of partner satisfaction, it would be appropriate to periodically monitor the achievement of planned project outputs. These should be incorporated into the project workplan as milestones for ease of appraisal. Where project outputs are not being achieved within the agreed timescales, the Project Manager should initiate discussions with relevant team members and, if appropriate the Steering Committee, and decide a course of action. Report the results – both good and bad – to the Project Team as a whole and the Steering Committee.

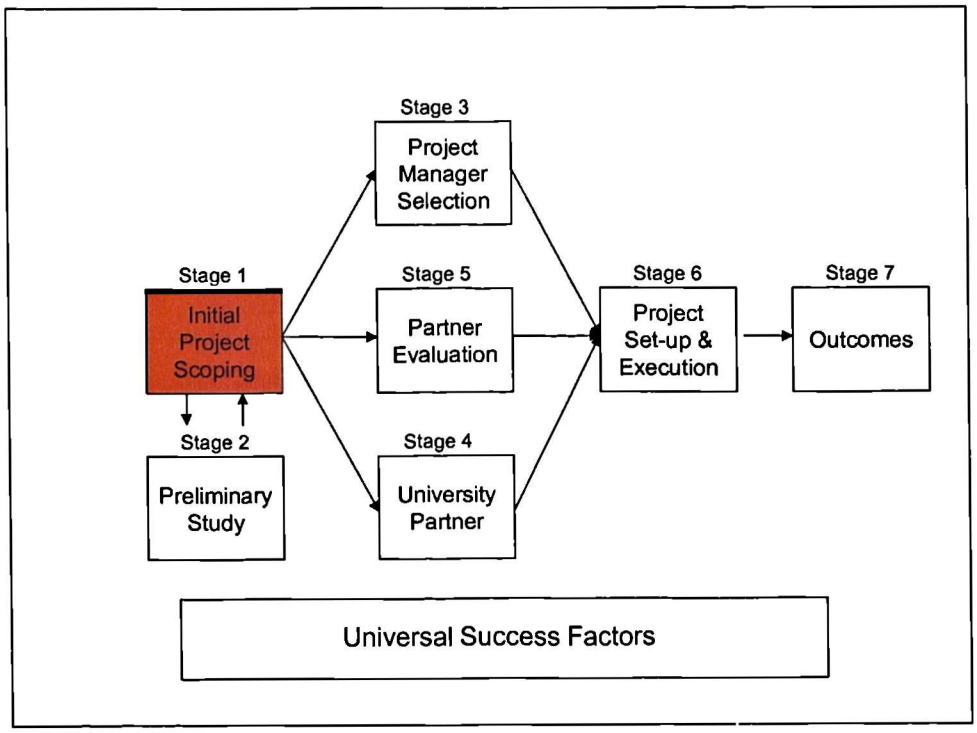
Part II

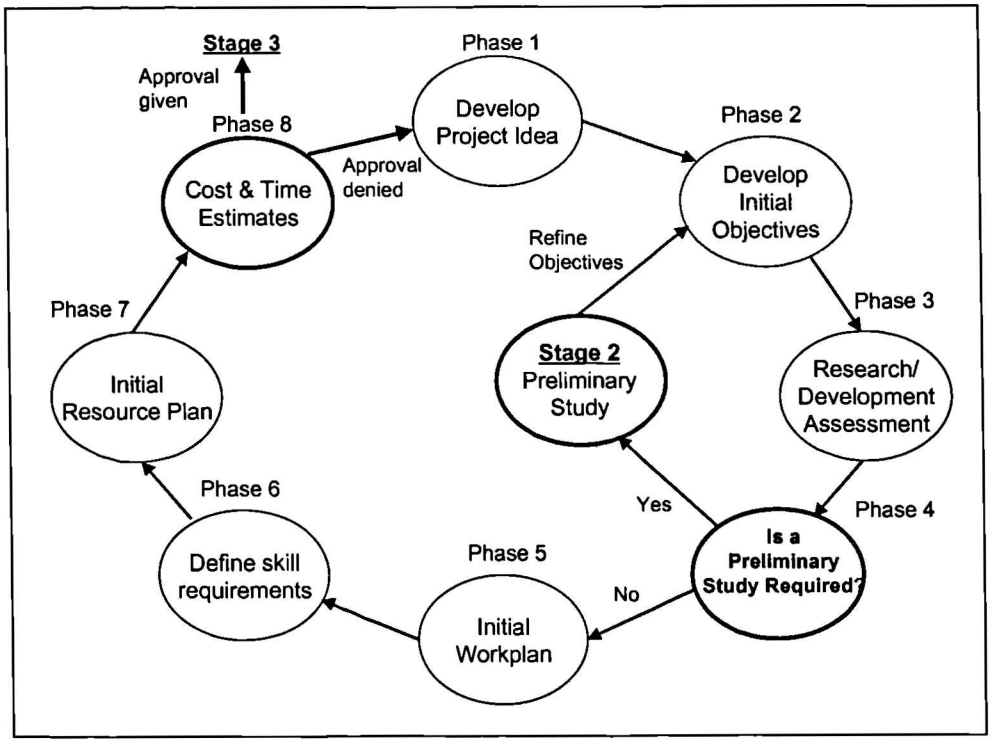
Guide Notes

Stage 1

Initial Project Scoping

1. Initial Project Scoping





1. Initial Project Scoping

The *Initial Project Scoping* stage describes the preliminary steps that should be taken prior to the start-up of any collaborative project, in order to ensure that the project is properly defined and set-up. By ensuring that the recommendations of this element of the Framework are carried out, the Project Manager can avoid problems associated with over-ambitious and unclear objectives. The guidelines presented here are also designed to ensure that a collaboration starts off with an appropriate level of resource and with all the skills and expertise needed for the project to succeed. Research has shown that realistic aims, clearly defined, mutually agreed objectives and adequate resources are critical to project success. It is therefore essential that these initial planning and scoping stages are carried out in order to avoid delays and problems later on in the project.

1.1 Phases 1 & 2 - Develop Project Idea & Develop Project Objectives

Phase 1 is the start point of any project, the generation of the project idea. At this early stage it is likely that the actual goal of the project will be quite vague. Size of project, complexity and technical uncertainty can make the task of identifying clear goals and objectives very difficult [1]. Nonetheless, it is important to attempt to set some kind of boundaries on the project's scope, i.e. to determine exactly what will form part of the project and what will not [2]. This can be done simply by determining what circumstances would constitute the end of the project. These circumstances can then be documented into some form of specification [2].

Alternatively, Kijne *et al* [3] recommend that a "hierarchy of objectives" be developed for the project, Figure 5. This technique forms part of a project management tool known as GOPP (Goal Orientated Project Planning), a tool that has been extensively used for SPRINT projects. A hierarchy of objectives fixes project objectives at different levels, beginning with the "overall goal" at the most global level of the project's objectives.

The "overall goal" is not an objective that any one single project can achieve. Rather it constitutes a definition of the wider goal to which the project is expected to contribute. The next lower level of objectives is the "project purpose" and this is the stage at which the project level objectives and purpose are defined. The lowest level of objectives is the "project results" which define what results will be achieved in realising the project purpose [3].

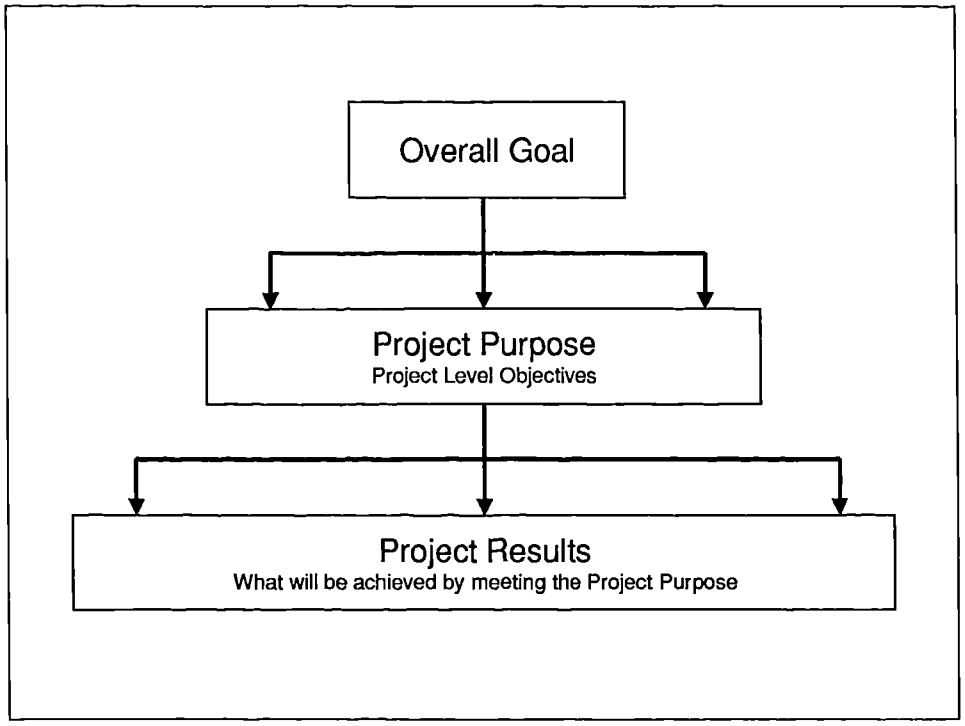


Figure 5 A Representation of a "Hierarchy of Objectives" [3]

In this way, the relationship between the different levels of objectives is made clear and the Project Manager is therefore better able to identify mismatches between levels and determine whether or not the scope of the project is appropriate. Further, by identifying what "project results" would need to be achieved in order to fulfil the "project purpose", the Project Manager can begin to assess the project's resource needs.

The achievement of the initial objectives is a commonly used measure of project success. It is therefore important that the project's objectives and results be defined with a maximum of realism [3].

WARNING *- A failure to define clear and realistic project objectives has been shown to have a detrimental effect on project success.*

1.2 Phase 3 - R&D Assessment

The R&D assessment phase recognises that the form of project management most appropriate to a given project will vary substantially depending on whether it is a "research" or a "development" project. The R&D assessment tool allows a project to be identified as embodying one of three possible types of R&D - *incremental*, *radical* or *fundamental*. Each R&D type consists of a different mix of "R" and "D" elements and by identifying where a project fits within these R&D types, it is possible to direct the project manager toward a more appropriate model for project management, and to make recommendations regarding the type of personnel and type of partners that the project will require in order to be effective. The work of Coombs *et al* [2] presents a particularly useful set of models which describe the different management approaches required for different levels of "R" and "D" work.

1.2.1 R&D Assessment Tool

Use Table 1 below to identify which type of R&D the proposed project represents [4]:

Table 1 R&D Assessment

Type of R&D	Description of Type	Characterisation of Type	Mix of "R" & "D" Elements
Incremental	Small advances in technology achieved not by uncovering & applying new knowledge, but by clever exploitation of existing knowledge in new ways	Low risk Modest reward	Small "r" Large "D"
Radical	The creation of knowledge new to the company, and possibly new to the world, for a specified business objective	Higher risk, i.e. higher than for *Incremental R&D* High reward	Large "R" & often large "D"
Fundamental	A scientific/technological reach into the unknown - the creation of knowledge new to the company, and possibly new to the world, to broaden & deepen the company's research competence in fields of potential future technology which will have a long-term strategic impact.	High risk Uncertain applicability to business needs.	Large "R" No "d"

1.2.2 The R&D Capability of Partner Companies

Matching the type of R&D to be conducted with the R&D capability of the industrial partners can be critical to the success of the project. In situations where the partner company will be expected to contribute meaningfully to the research/development work and where the project is categorised by *radical* or *fundamental R&D*, the R&D capability of the partner company will be a significant factor for success. Clearly, where a partner is required only to supply materials, funding or technical support, i.e., *resource* or *technical* support, R&D capability may prove irrelevant. Similarly, a high R&D capability is not likely to be a significant factor for success in a project characterised by *incremental R&D*. Where an assessment of R&D capability is necessary, the Checklist below offers some suggested indicators:

- The company's annual expenditure on R&D
- The rate at which the company produces new products relative to competitors within the same sector
- The company's reputation as an innovator
- Innovative firms have been shown to out-perform non-innovating firms with respect to profitability. Further, innovative firms have been shown to be far less sensitive to economic recession than non-innovators with respect to both profitability and growth rates [5].

The information required to make such an assessment could be obtained from the company itself or from the company's Annual Report.

WARNING *- A project is unlikely to succeed if the roles assigned to collaborative partners require a higher R&D capability than those companies possess.*

1.2.3 Implications for the Project Team

Clearly, the type of R&D to be undertaken within the project also has implications for the selection of suitable personnel in forming the Project Team, particularly with respect to projects characterised by a large "R" content, e.g. *radical* and *fundamental R&D*.

The table below provides suggested levels of "R" and "D" experience and academic training to consider in selecting members of the Project Team, Table 2:

Table 2 R&D Capabilities of Project Personnel

Partner	Incremental R&D	Radical R&D	Fundamental R&D
Academic	Research training/experience is desirable but not necessarily critical	Research training/experience at doctorate level is critical to success	Research training/experience at doctorate level is critical to success
Industrial	Experience of "D" projects	Experience of "R" and "D" projects. Project Manager should preferably have research experience	Experience of "R" projects. Project Manager should preferably have research experience

Important Note: *Clearly, not all members of the Project Team need be optimally qualified. For example, where the Project Team includes a highly experienced academic as Lead Researcher, it should be possible for the Lead Researcher to direct the research and supervise less experienced academics and student researchers, while the Project Manager concentrates on the broader management issues. Therefore, it is possible to run the project effectively with a Project Team consisting of a range of abilities and experience.*

1.3 Phase 4 - Preliminary Study Decision Point

The *Preliminary Study* is designed to reduce unnecessary risk and uncertainty in R&D projects by investigating the implications of technical, commercial and other external factors such as legislation, that are likely to have an impact on the project. The *Preliminary Study* should therefore provide the Project Manager with the information needed to set reasonable boundaries on the scope of a collaborative project, and to enable the project to be defined in such a way that the risk of external factors having a substantial impact on the project's purpose and direction are minimised.

Phase 4 constitutes a decision point. Consider whether or not a Preliminary Study would be appropriate in order to further refine the project's objectives. Use the Checklist below to determine whether or not a Preliminary Study is advisable [6]:

- Are there any factors associated with the external environment, e.g., government legislation (existing or forthcoming), that are likely to have an impact on the purpose and direction of the intended research work?
- Are there a number of possible technological solutions which the project will need to evaluate in addressing the intended problem?
- Is the basic formulation/specification of the product/process/technology central to the project as yet unknown?
- Is the precise nature of the equipment that will be used to produce the product (or deliver the process or technology) as yet unknown?
- Is the market for the product/process/technology as yet unknown?

If the answer to any of the above questions is "Yes" then the project is subject to considerable uncertainty and risk and a Preliminary Study is advisable.

R&D is by nature inherently uncertain and collaboration provides a means of reducing the risks involved [6]. However, if the factors in the above checklist have not been resolved, considerable uncertainty exists within the project which could (and should) be minimised before proceeding. A preliminary study conducted prior to the collaborative research project could be used, for example, to reduce the number of potential technological solutions needing to be addressed by eliminating those which are not commercially viable. In this way, a considerable amount of uncertainty and risk is removed from the project at the outset, providing the project with a sharper focus and, through reducing inherent risk and uncertainty, making it more attractive to prospective collaborative partners.

If a preliminary study is conducted at Phase 4, it is important to note that the results of the study will of necessity reshape the purpose and objectives of the project. Therefore, on completion of the preliminary study, the project objectives and specification developed at Phase 2 will need refining before proceeding to Phase 5.

If a preliminary study is deemed necessary refer immediately to Section 2 - Preliminary Study. Otherwise progress to Phase 5.

WARNING *- Without a preliminary study projects can attempt to cover too much ground and in thus failing to achieve some or most of its original objectives, the project is likely to be considered a failure.*

1.4 Phase 5 - The Initial Workplan

At this stage the initial workplan for the project should be defined. As with the project objectives, certain elements of the workplan will be vague at this early point in the project's development. However, it is important to develop the workplan as far as possible in order to:

- Ensure that the project's objectives are realistic
- To define the likely requirements in terms of manpower and equipment, and
- To give prospective partners confidence in the project

The workplan should therefore include a set of project milestones (a series of targets which will guide the project toward its ultimate goal) and a work breakdown structure whereby the project is broken down into a series of sub-projects (Work Packages or tasks), each designed to contribute a specific element of the work [7, 8]. By developing a work breakdown structure the interrelationships between the various sub-projects is made clear. Section 6-4 (The Workplan) provides references to appropriate background reading in this area.

From the above a list of jobs/activities can then be determined which will provide a specification for the project's requirements in terms of manpower, expertise and equipment. From these jobs/activities it is possible to discern the basic roles that collaborative partners will be required to undertake within the project. Finally, initial timescales for the completion of each job/activity should be incorporated into the workplan, thereby providing a further means of assessing how realistic the project's scope and objectives are.

Project planning should be regarded as an incremental process. The view that because all project activity cannot be planned to the same level of detail, there is little need to plan at all, is simply not valid [9]. A more realistic approach is to consider that since long term risks occur in the long term, they need not be known to same extent as the near term risks. This approach is illustrated by the "folded map" concept described by Gilbreath [9].

WARNING *- Failure by the Lead Partner to clearly establish the goals of the project and the means by which these goals will be achieved at the outset, does little to instil partners with confidence.*

1.5 Phase 6 - Define Skill Requirements

The initial workplan developed at Phase 5 will have provided a basic specification for the project by dividing it into a series of sub-projects or Work Packages and defining the jobs/activities associated with each element. Through this basic specification it should now be clear what skills and expertise are required in order for the project to succeed in meeting its goals. The basic roles defined at Phase 5 will each require a certain type (or range) of skill(s) and expertise. Once defined, these requirements can be used as a basis for evaluating partners with the appropriate skills/expertise to undertake each role. Similarly, this specification can be used to define the resource requirements to be provided by the university partner(s).

At this stage, it is also important to refer to the results of the R&D assessment (Phase 3). The type of R&D to be undertaken (as determined through the R&D assessment tool) will necessarily have a bearing on the type of partners and university personnel that will be most appropriate to the project. Produce a list of the roles to be undertaken by partners to the project (both industrial and academic), define the skills and expertise required for each role and the R&D capability required of each partner in order to fulfil each role. The result should be an (industrial) partner specification for each role and a specification for the university partner(s) research team, detailing an appropriate mix of experienced researchers, student researchers and technician support.

1.6 Phases 7 & 8 - Initial Resource Plan & Cost & Time Estimates

Phase 6 will have provided a specification for the manpower resource requirements for the project, as defined from the project's initial objectives (Phase 2). A similar exercise can also be carried out to determine the equipment requirements of the project. Where the academic partner(s) is(are) already known, it should be possible to establish how much of the equipment needs can be provided by the university partner(s). Where equipment requirements are associated with the role of one of the industrial

partners, this information can be added to the industrial partner specifications developed at Phase 6.

Combine the information regarding manpower and equipment resource requirements to produce a Resource Plan that can be used to provide a cost estimate for the project. Time estimates based on the initial workplan and the defined level of resource should also be produced.

Phase 8 provides the opportunity to review the project plan and determine the funding requirements based on the information generated. The Lead Partner and any other partners or prospective partners involved at this early stage, can then take the decision either to proceed as planned or where appropriate, to re-iterate the loop (Phases 1-7) in order to reduce/expand the project scope.

1.7 Concluding Comments

The *Initial Project Scoping* element of the Framework describes the initial project planning and scoping stages which should be carried out prior to the start-up of any collaborative project. The objectives, workplan and resource plan that should result from this initial stage will, of necessity change, as collaborating partners are identified - the individual objectives of the collaborators must be harmonised such that the project embodies a shared purpose. Nevertheless, it is important that this initial planning takes place in order that an appropriate choice of collaborators can be made and to ensure that all partners begin the project with some idea of what the project is intended to achieve and, where possible, some notion of how it will be achieved.

References & Further Reading

[1] Morris, P.W.G. & Hough, G.H., The Anatomy of Major Projects – A Study of the Reality of Project Management, *Wiley*, 1987, 1st Edition, Ch. 11.

[2] O'Connell, F., Project Management How to Run Successful Projects, *European Commission DG XIII*, Proceedings of an International Conference on "The Role of Technology Transfer Projects in the Innovation Process", 1995, OP-EUR/17010, p242-246.

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[4] Roussel, P.A. et al, Third Generation R&D - Managing the Link to Corporate Strategy, *Harvard Business School Press*, 1991, 1st Edition, Ch. 2 & 4.

[5] Geroski, P. & Machin, S., Do Innovating Firms Out-perform Non-innovators?, *Business Strategy Review*, 1992, Summer, p79-90.

[6] Porter Lynch, R., The Practical Guide to Joint Ventures & Corporate Alliances, *Wiley*, 1989, 1st Edition, Ch. 11.

[7] Reiss, G., Project Management Demystified – Today's Tools & Techniques, *E & F.N. Spon*, 1995, 2nd Edition, Ch. 10.

[8] Meredith, J.R. & Mantel, S.J., Project Management – A Managerial Approach, *Wiley*, 1995, 3rd Edition, Ch. 5 & 8.

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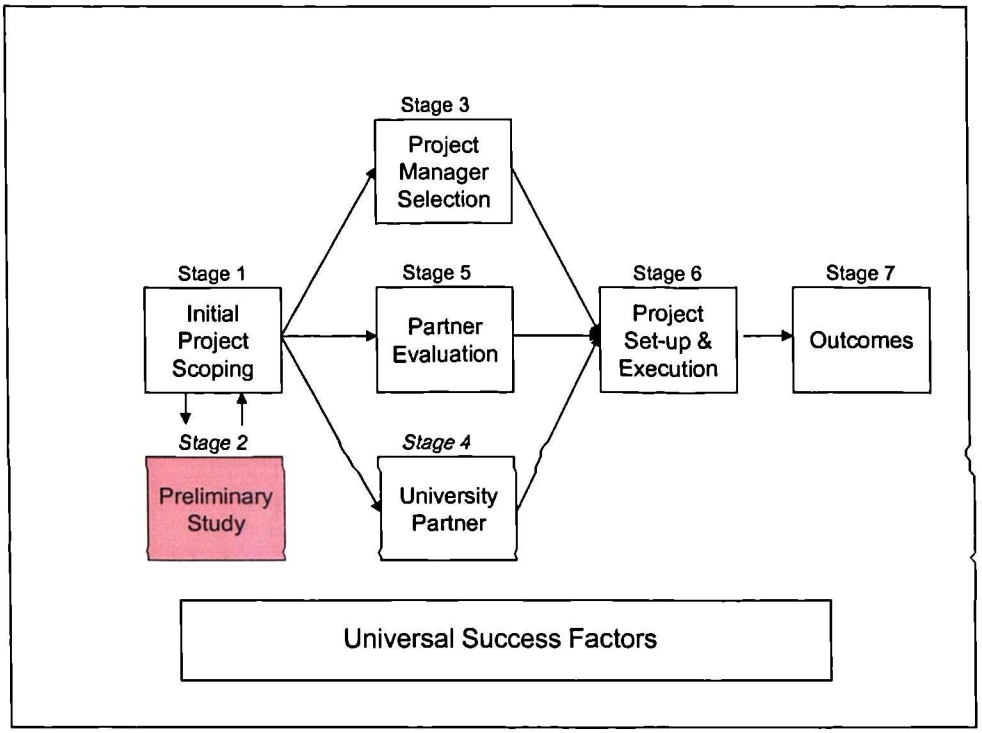
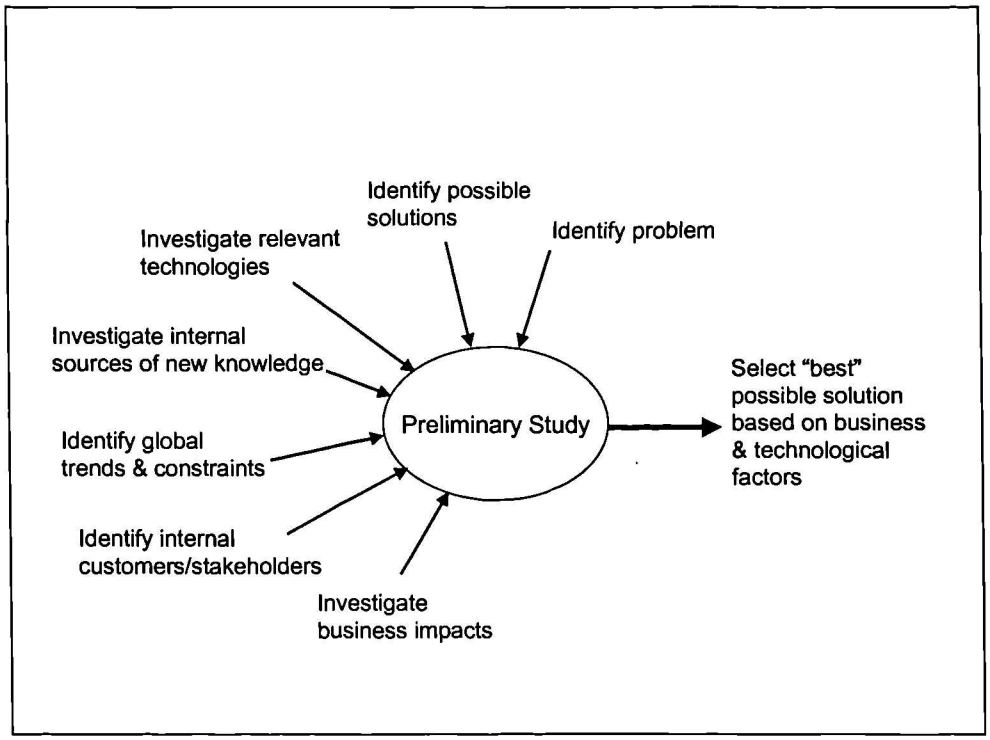
Stage 2

Preliminary Study

2. The Preliminary Study





2. Preliminary Study

The importance of a preliminary study in refining the objectives and scope of a collaborative R&D project and in reducing inherent risk and uncertainty, has already been made clear in Section 1 (Phase 4). The main aim of a preliminary study in the context of an R&D project is to identify the full range of possible technological solutions to a problem and then explore the technological and commercial issues associated with each of them, and any other constraints such as legislation, with a view to narrowing the field down to a smaller number of preferred solutions.

Each solution will incorporate an inherent level of technical difficulty and will have definable commercial implications such as the cost to develop the technology, limitations regarding the volume of product that can be economically produced, or acceptability to the market with regard to environmental concerns, for example. In the case of new product development, the importance of making a careful assessment of the technical risks and market demand has been particularly emphasised [1].

A preliminary study can also be useful in identifying, or simple verifying, any global trends or constraints (e.g. legislation, standards or patents) which could have a direct bearing on the aims of the project. Such factors can then be monitored throughout the project, enabling the Project Team to react more quickly and flexibly to changes in the external environment.

Further, the study can be used to identify internal sources of new knowledge of direct relevance to the project and to identify internal customers and stakeholders. In large organisations in particular, it is easy to overlook useful internal sources of knowledge and expertise. The identification of internal customers and stakeholders provides the opportunity to further refine the project's objectives to reflect their needs and thereby enhance internal support for the project.

The result of a preliminary study therefore should be:

- *A smaller number of potential solutions on which to concentrate the project work, which represent the "best" balance of technological and commercial implications given the particular circumstances,* ***or***
- *A more refined specification of the project work, based on a thorough analysis of the technical and commercial implications,*

+

- *A clearer understanding of the external trends and constraints which could have an impact on the project*
- *A clearer appreciation of internal sources of knowledge and expertise and the needs of potential internal customers and stakeholders.*

References & Further Reading

[1] Cooper, R.G. & Kleinschmidt, E.J., Winning Businesses in product Development: The Critical Success factors, *Research Technology Management*, 1996, July-August, p18-29.

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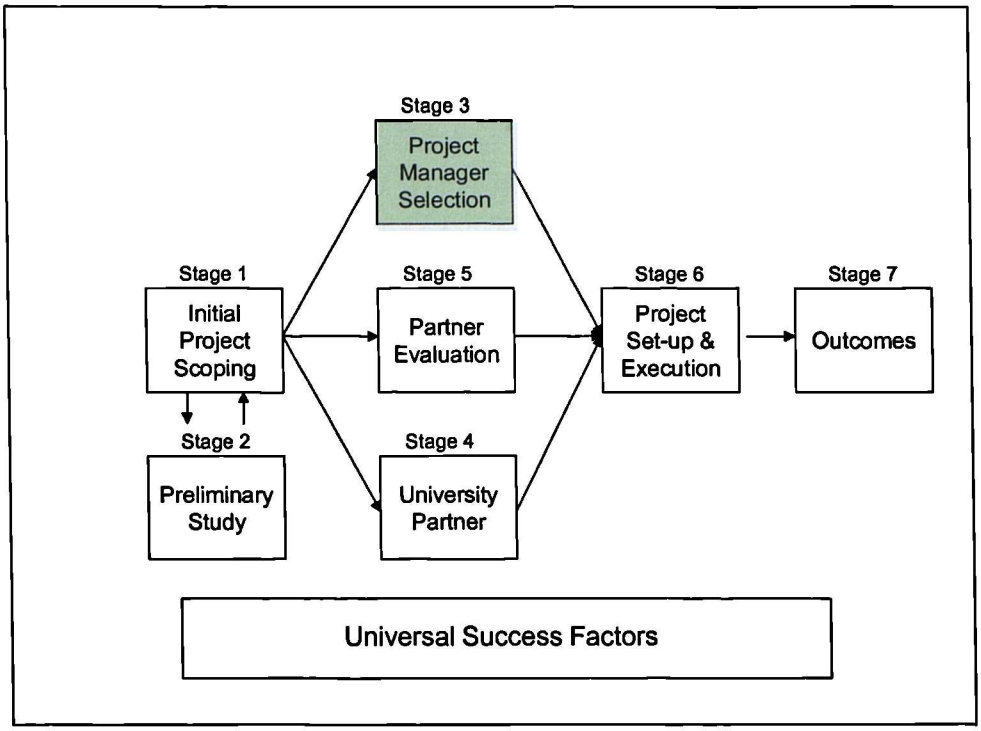
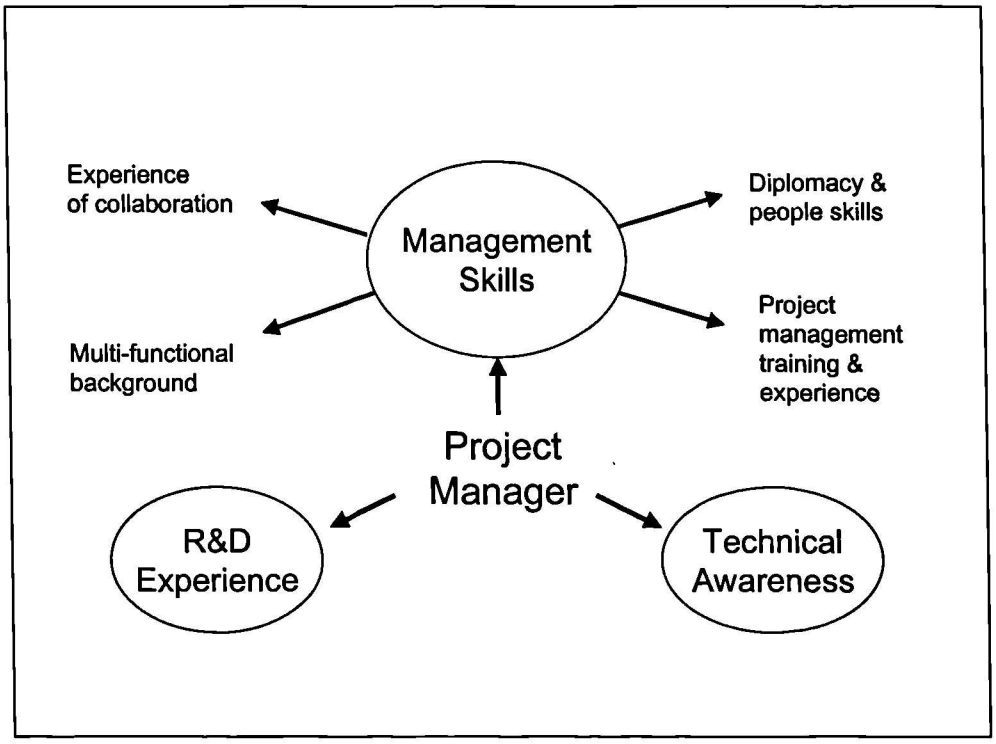
Stage 3

Project Manager Selection

3. Project Manager Selection





3. Project Manager Selection

Research indicates that only high quality Project Managers should be assigned to run collaborative projects. Collaborations are difficult to manage because, by their very nature, they require the Project Manager to harmonise the differing objectives, perspectives and modes of operation of a number of often diverse organisations. Furthermore, since collaborations span organisational boundaries the Project Manager has no direct authority over the participants and must therefore rely on diplomacy to ensure that partners deliver and that targets are achieved. Communication and the co-ordination of activities can also be difficult where the Project Team is not co-located in some central facility.

In the Framework the critical importance of the Project Manager to collaboration success is recognised and the following section provides guidance as to the type of skills, experience and characteristics that are appropriate to the successful fulfilment of such a key role.

3.1 Management Skills

3.1.1 Diplomacy

Managing collaborative projects is difficult, not least because the Project Manager has no direct authority over the parties involved. Diplomacy is therefore a key skill, necessary in dealing with internal politics and for the day-to-day management of collaborative projects that span organisational boundaries and therefore offer the Project Manager no formal authority to influence critical company decisions [1-4].

"Getting things done in your own organisation is often difficult enough, but it requires great diplomacy and powers of persuasion to get things done the way you want them in others" [5].

3.1.2 Experience of Collaboration

Prior experience of collaboration seems to improve the probability that a given project will be successful. It has been suggested that this is because managers experienced in collaborations better understand what a collaboration can (and cannot) do [3]. It has also been suggested that partners experienced in collaborations tend to be more relaxed and are more willing for a little give and take to occur between themselves and potential partners, as they work toward achieving a satisfactory compromise [3].

Others indicate that an element of management learning takes place with increasing experience, which allows an experienced partner to mitigate risk and thereby increase the likelihood of a collaboration being successful [6]. The issue of learning is of particular importance.

Important Note: *Experience alone is not enough to guarantee good future collaborative performance. The key is in learning from the success and failures of previous collaborations and applying the lessons to subsequent partnerships [7].*

Therefore, "experience" in this context assumes that such learning has taken place.

3.1.3 Multi-functional Background

It has been suggested that previous experience of at least two functional areas can be important in assuring the experts and specialists within a collaboration that a manager has a degree of competence [2]. More generally, experience of other functional areas will allow a Project Manager to understand the differing perspectives of for example, the R&D function versus the production department. Such experience could prove important in overcoming inadequate interface management such as that described in a report on the Alvey Programme for Advanced Information Technology [8]. In particular, the transfer of research work to one of the partner companies for further development, is a process which may benefit from a broader perspective on the part of the Project Manager.

3.1.4 Project Management Training & Experience

Despite the considerable importance placed on people skills such as diplomacy, there is nonetheless a need for basic training and experience of project management. The basic skills of overseeing project objectives, budgetary control and manpower management are particularly important in maintaining the confidence of industrial partners. Further, such factors also tend to be used as criteria for measuring project success, not least because they are easily measurable. However, whilst a grounding in the important methods and techniques of project management is a useful asset, it is equally important that the Project Manager possess a basic ability to organise others, and this is a skill which can be developed as experience increases [2, 9].

3.2 Technical Awareness

Note that the emphasis here is on technical *awareness* rather than technical *expertise*. It is not necessarily important for the Project Manager to possess technical *expertise* in a field relevant to the project. On the contrary, a "non-expert" team member can bring a substantially different perspective to technical discussions and can be extremely useful in exposing inappropriate

assumptions, generating alternative ideas and identifying weaknesses in arguments regarding both technical and non-technical issues.

Some have taken the approach, generally in collaborations of a highly technical nature, of appointing two Project Managers - a business manager and a technical manager [2, 10]. However, in collaborative projects involving a university partner it should be possible for the Lead Researcher to assume responsibility for the technical issues. Furthermore, careful selection of the researchers and industrial partners should provide the project with an adequate level of technical expertise in all relevant fields.

Technical *awareness* on the part of the Project Manager can however be useful in so much as this will allow the Project Manager to appreciate the extent of any technical difficulties which might arise during the project. The Project Manager can therefore ensure that sufficient contingencies are made in the project planning to allow for such difficulties.

3.3 R&D Experience

In the context of R&D projects a certain amount of R&D experience can be important with regard to project management. In particular, it is important that the Project Manager understand that a different approach to project management is appropriate for *research* projects compared to *development* projects. At the fundamental level, *research* is defined as "an orderly approach to the revelation of new knowledge about the universe". Therefore, while the purpose of *research* is to develop new knowledge, the purpose of *development* is "to apply scientific or engineering knowledge; to expand it; to connect the knowledge in one field with that in other fields" [11]. As such, it has been proposed that it is not appropriate to apply the same model of project management to both *research* projects and *development* projects [12].

However, whilst some appreciation of the distinction between research and development projects and prior experience of R&D would be a useful asset in a Project Manager, its relative importance will vary depending on the type of project to be undertaken. Section 1 showed how R&D projects can be categorised depending on the relative levels of "R" and "D" in a project. Where a project is largely developmental in focus, the research experience of the Project Manager will be irrelevant. However, in the context of a research-orientated project, some basic understanding of the principles of research on the part of the Project Manager would allow him/her to better understand the inherent uncertainties and constraints involved in planning and running a research project.

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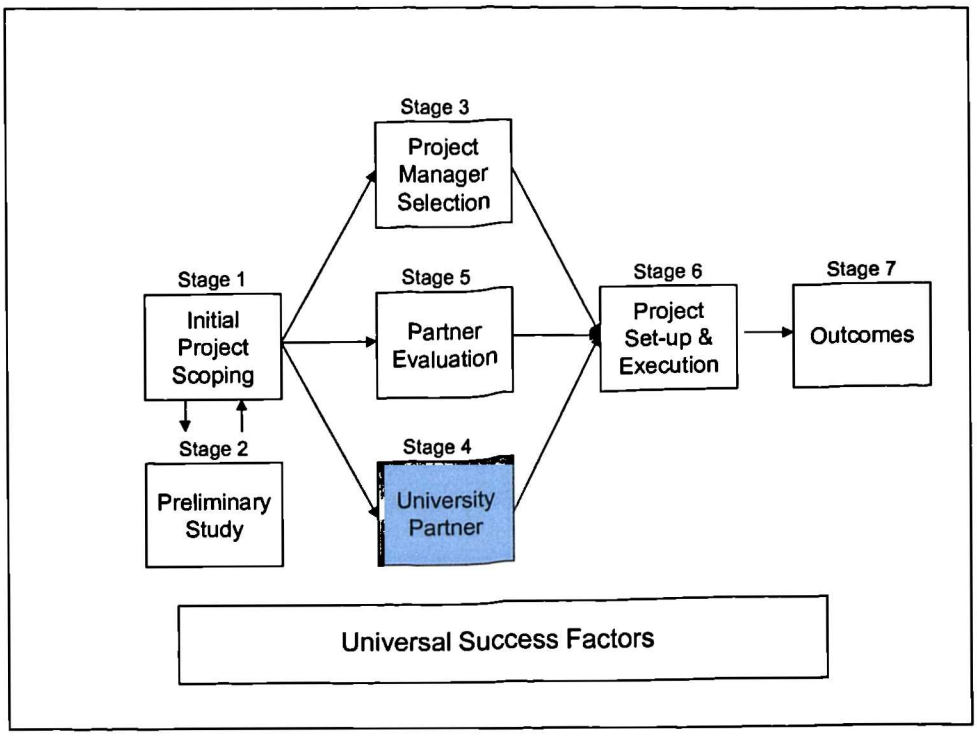
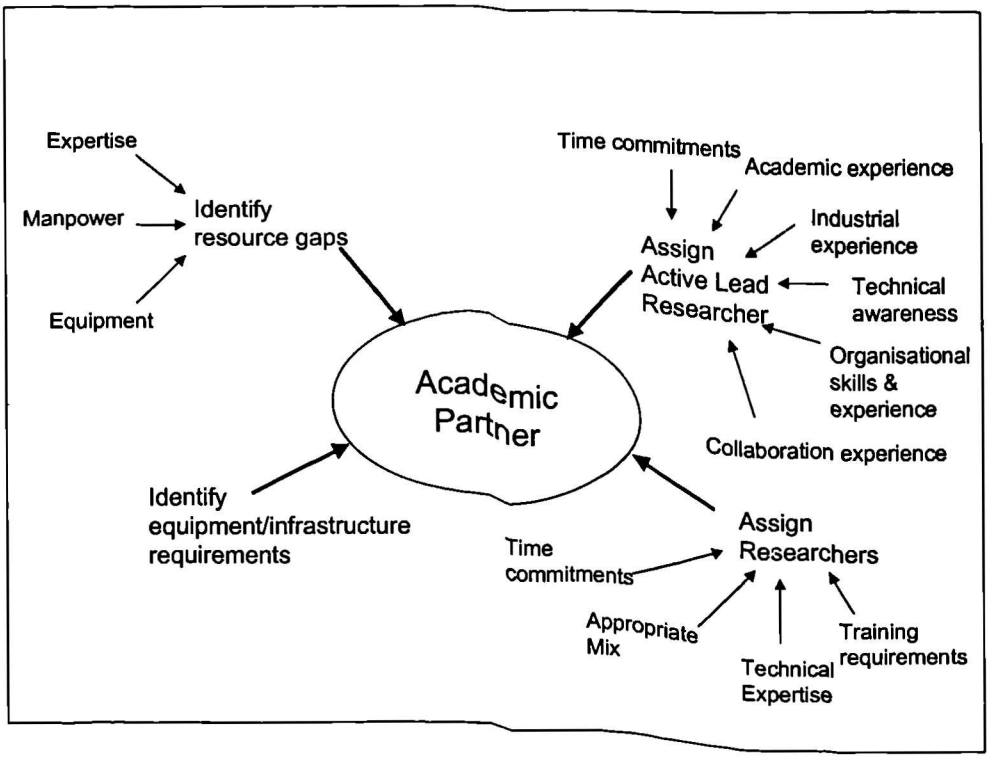
Stage 4

The University Partner

4. University Partners





4.1 Introduction

Collaborations involving university partners introduce an additional element to the management process. University partners are attractive to industry because of the specific knowledge and expertise they can bring to a collaboration. However, it is recognised that a "cultural gap" exists between academia and industry, characterised by their broadly differing perspectives, priorities, and differing expectations with regard to desired outputs and timescales [1-3].

Nevertheless, effective collaboration management, whereby the views, objectives and desired outcomes of *all* partners are taken into account, should minimise any adverse effects of such cultural differences. Many of these cultural issues are addressed as part of the recommendations made with respect to *Project Set-up & Execution* (Section 6). However, there are issues that are specific to managing the role of the university partner, that need to be addressed at an early stage in the set-up of a collaboration, and which if managed properly will reduce problems and delays later on. These are the issues addressed by this part of the Framework.

4.2 Assigning a Lead Researcher

The Lead Researcher has a critical role to play in the success of a university-industry collaboration. A collaborative project involving a university partner will tend to run more smoothly where the Lead Researcher and the Project Manager (who will tend to be from industry) work closely to co-ordinate the efforts of the university Researcher Team and the industrial partners. To that end, it is suggested here that the Lead Researcher role should involve managing the research work being carried out by the university team, liaising with the industrial Project Manager and ensuring that academic best interests are appropriately represented.

The responsibility that such a role entails implies that, like the role of Project Manager, the Lead Researcher role is not one which should be taken lightly and it is suggested therefore, that a certain background with respect to training and experience can improve the effectiveness with which the role is carried out. In many cases, and especially where a collaborative project has been awarded public funding, the Lead Researcher will have been involved in the project from the earliest stage. Therefore clearly, the recommendations made here are not intended necessarily to be used as a means of selecting an appropriate candidate. However, it is suggested that in areas where the Lead Researcher lacks experience or training, it is important to recognise the fact and attempt to fill the gap by, for example, assigning researchers to the Researcher Team who can compensate for this shortfall, or by offering the Lead Researcher additional help or training.

4.2.1 Academic & Industrial Experience

Academic experience is an obvious pre-requisite for the role of Lead Researcher and the degree of responsibility that the role entails. A track record for the successful supervision of students is an important element of that experience, since it is common for a Researcher Team to include a number of post-graduate students. However, it should be noted that the importance of academic experience will vary dependent on the nature of the project. In a *radical* or *fundamental* research project (Stage 1) academic experience will be much more important than in the case of an *incremental* research project with a strong industrial bias. This therefore, is an area of the Framework where the evaluation it provides must be interpreted in light of the particular circumstances of each collaboration.

A degree of industrial experience is also very desirable in joint collaborations involving industry. In particular, an awareness of industrial issues and an appreciation of the different pressures and priorities to which companies are subject can be very helpful in gaining the respect of industrial partners and in overcoming the inevitable cultural differences. However, as an experienced academic, the Lead Researcher should also be capable of ensuring that academic progress is properly served, despite the need to accommodate industrial urgency.

4.2.2 Organisation Skills

Given that it is desirable for the Lead Researcher to undertake the responsibility of managing the Researcher Team, the ability to effectively organise people and project activities is an important factor. However, the Lead Researcher need not necessarily have received formal project management training in order to be effective in this respect. Formal project planning activities will most likely be managed by the Project Manager. However, by organising the activities of the researchers and ensuring that researchers are aware of the importance of meeting agreed milestones and targets, the Lead Researcher can have considerable influence on the success of the project and earn the confidence of the industrial partners.

4.2.3 Time Commitments

Ensure that the Lead Researcher has sufficient time available to carry out the role effectively. It will rarely be the case that the Lead Researcher can devote 100% of his/her time to this one role. Other commitments such as student supervision, lecturing, writing papers for publication and examination board duties, must be taken into account in determining how much time the Lead Researcher can realistically commit to the project. Where the Lead Researcher is unable to commit sufficient time to the project, arrangements need to be made to provide additional help, e.g. by electing one of the

Research Team to take on some of the management work, or by assigning an extra person to the project.

4.3 Assigning Researchers

The remainder of the Researcher Team will be assigned primarily on the basis of their particular expertise and experience with respect to the project's requirements. However, there are other issues to take into account.

4.3.1 Establish Researcher Interest

Ensuring that the researcher is sufficiently interested in the proposed research is a factor which may be overlooked, but it is important in building a committed and enthusiastic Research Team.

4.3.2 A Proactive Attitude

A proactive attitude towards the work can also be helpful since industrial members of the Project Team will tend frequently to be distracted from the project by other pressing matters within their own organisations and may occasionally need their attention to be drawn back to the project.

4.3.3 An Appropriate Mix of Skills

Within a project there will be a range of skill needs, requiring individuals with different skills and skill levels. Therefore, the Researcher Team may include experienced academics, student researchers and technicians. It is however, important to ensure that the mix of personnel correctly reflects the skill needs of the project. There is little point in, for example, assigning a student researcher to tasks requiring the skills of an experienced academic, or similarly to charge a technician with tasks that require the skills of a researcher.

Student researchers, in particular, need to be deployed with care in order to achieve maximum benefit from them. Student researchers, by nature of the qualifications they are undertaking, have a very definite agenda of their own and as such constitute a less flexible resource than other researchers. Student researchers will perform best when assigned to work on an area which has:

- Sufficient depth and breadth to meet the requirements of the degree qualification for which they are registered,
- Definite boundaries in terms of the scope of the project area to be investigated (i.e., what will be investigated and what will not),
- A low likelihood of the scope and/or direction of the project changing appreciably over time.

The last point in particular, is difficult to achieve in a rapidly changing technological environment, but it is nevertheless important to select work areas that meet these criteria as closely as possible.

Furthermore, while a certain degree of responsibility is undoubtedly good training for a future career, students should not be unnecessarily burdened with responsibility since this will detract from what they need to achieve in order to earn their degree qualification. However, students should certainly be encouraged to periodically present their findings to their industrial sponsors. Such an exercise will provide the student with valuable feedback regarding the relevance, usefulness and validity of their work, whilst the industrial partners will welcome the opportunity to assess progress. The frequency of such activities should however take into consideration the fact that preparation time (for reports and presentations) will reduce the amount of time available to do research work.

4.3.4 Time Commitment

As with the Lead Researcher, it is important to ensure that the researchers assigned to the project have sufficient time available to carry out their individual roles effectively. Except in cases where researchers are employed specifically to work on the project, other commitments such as student supervision, lecturing, writing papers for publication and examination board duties, must be taken into account in determining how much time a researcher can realistically commit to the project. In the case of student researchers, there may be other commitments such as taught elements of their degree courses which need to be taken into account.

4.4 Equipment/Infrastructure Requirements & Identifying Resource Gaps

In order to avoid unnecessary delays later in the project, equipment and infrastructural needs should be identified at the earliest possible stage. Of these requirements, those that can be met by the university can then be assessed further to identify any special arrangements or constraints associated with them. For example, it would be advisable to ensure that the Project Team will be able to gain access to equipment/laboratory facilities when required.

The need to arrange for specialist personnel to be present to operate certain pieces of equipment, would constitute a special constraint which must also be taken into account in subsequent project plans. Failure to make such arrangements in advance could result in delays which will frustrate both the researchers and the industrial partners. Similarly, early identification of resources gaps, i.e. a shortfall in skilled personnel, certain areas of expertise and equipment/infrastructural requirements, should also enable action to be taken that will prevent delays later on.

Important Note: *Careful project management should enable the detrimental effects of the so-called "cultural gap" between academia and industry, to be effectively minimised whilst still allowing the collaboration to benefit from the different strengths of both parties.*

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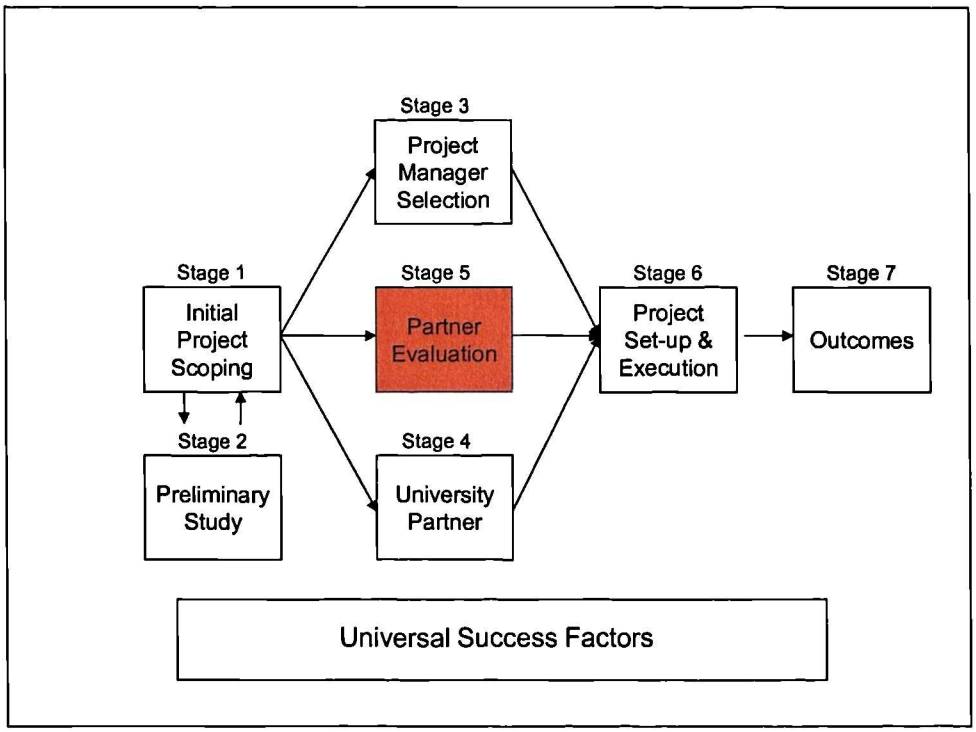
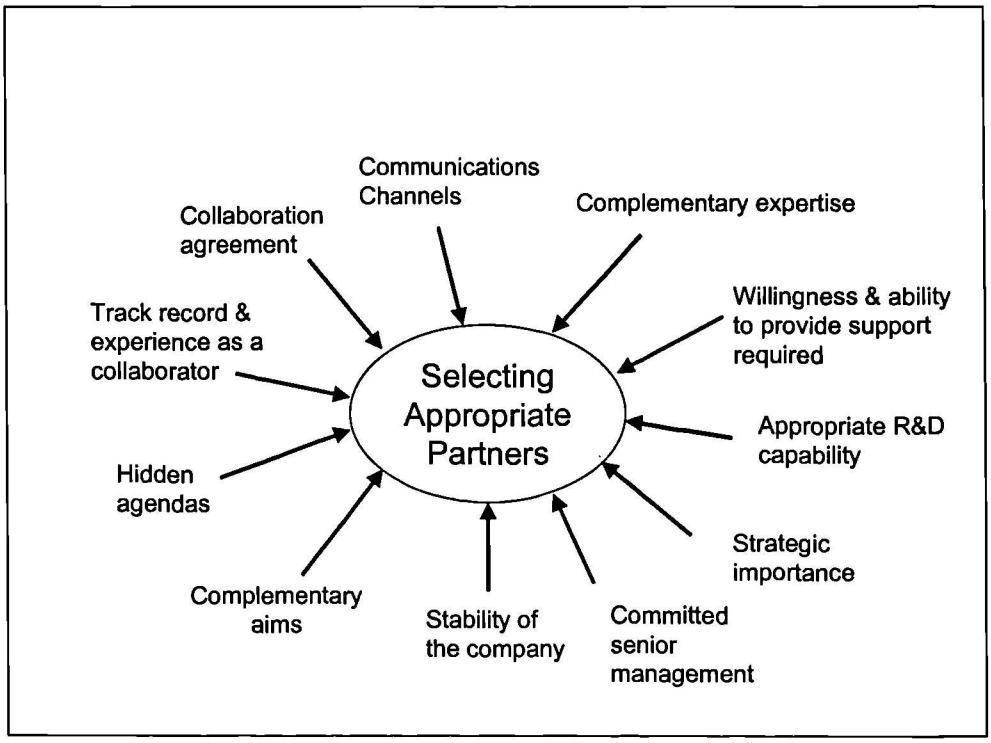
Stage 5

Partner Evaluation

5. Partner Evaluation





5.1 Introduction

Choice of partners in entering into a collaboration of any kind is considered to be the most critical decision affecting success [1]. It has been suggested that partner selection should be placed above all other considerations, since choice of partners is likely to have an effect on every aspect of the collaboration and its management [2]. However, in reality, there are often constraints which prevent the "free" selection of partners. As such therefore, the Framework offers a means of evaluating the inherent risk associated with each collaboration partner.

This stage of the Framework provides a partner evaluation process, whereby the collaboration initiators can assess partners for potential risk factors which, left undetected, could jeopardise the success of the collaboration. In identifying these risk factors the Project Manager is therefore afforded the opportunity for risk mitigation. It should be noted that, given the inherent difficulties of harmonising the different needs and perspectives of the partners, it is advisable to keep the number of collaborating partners to a minimum. That said, it is also important to ensure that a collaboration has available within it, all the resources and expertise required to achieve agreed goals. Therefore, a balance must be sought whereby the needs of the collaboration can be met with the minimum number of participants.

5.2 Initial Considerations

There are a number of important steps which must be taken before proceeding with the partner evaluation process:

5.2.1 Define Expertise Requirements, Roles & Responsibilities

Ensure that the full range of required expertise has been identified in order to avoid the need to bring in additional partners later on. Omissions could delay the project and new additions to the team could have an unsettling effect on existing partners, especially if the collaboration agreement has already been signed by the other partners.

Having a set of clearly defined roles and responsibilities within the collaboration means that partners can be made fully aware of what is expected of them from the outset. Without this information the collaboration may be hindered later on by partners who remain unclear as to what is expected of them, or partners who are not prepared to support the project to the extent originally intended.

5.2.2 Define the Type of Support Required

The level of support required is particularly important. For example, if it not made clear to partners at the outset that they will be expected to contribute meaningfully to the research or development work, a situation can arise whereby the partner believes that their role in the project is merely to provide funding, material and occasionally, some technical advice. Therefore, the type of support required should be clearly defined before evaluation of prospective partners begins.

5.2.3 Collaboration Track Record

Where there is some flexibility with regard to the selection of partners, it is advisable to avoid collaboration partners with whom your organisation has previously had an unsatisfactory alliance. The nature of the previous partnership is irrelevant. If your organisation has worked with a company before and found them to be unsatisfactory partners, their inclusion in the collaboration should be reconsidered. Note that information regarding previous partnerships may be available from other parts of your organisation, and it is therefore important not to limit the search to specific departments or areas of the business.

Alternatively, where a partner is previously unknown, it may be possible to contact other organisations with whom that company has previously collaborated and establish the company's track record as a collaborator through their views.

> ***Note:*** *Be aware that negative opinions regarding specific partners can be formed for a number of reasons and are subjective judgements. Consider the circumstances of any previous partnerships very carefully.*

5.3 Evaluation Factors

5.3.1 Appropriate Expertise & Required Contributions

There may be a tendency in evaluating collaborative partners to concentrate on the partner's expertise in a specific area and whether or not that company would be willing to contribute the required funding, materials and manpower. These are important factors and it is essential that the field of expertise and the type and level of support required are clearly defined beforehand. In particular, it is important to assess the extent of a partner's experience, capabilities and their potential for making a real contribution [3]. However, there are other equally critical factors to consider in evaluating a partner.

5.3.2 Strategic Importance

The strategic importance of the proposed collaboration to the partner should be clearly established. A collaboration which is perceived as being of significant strategic importance to a partner company will ensure that the proposed project enjoys a high profile within the partner organisation and the attention of senior management. As such, strategic importance is a key factor in winning the commitment of the partner organisation and in ensuring a meaningful contribution from them.

WARNING *- In collaborations involving strong customer-supplier relationships supplier companies may consider involvement in a partnership involving a customer to be sufficient grounds for considering it strategically important. However, such grounds alone do not guarantee that such partners will demonstrate commitment to the project work. There should therefore be sound commercial and technological grounds, other than those associated with a participating customer, for a company's involvement in the collaboration.*

5.3.3 Hidden Agendas

The above ***Warning*** provides an example of hidden agendas that can exist among partners. Hidden agendas have been cited as the single most important factor in the failure of joint ventures (a form of collaboration) [4], and there is no reason to suggest that the same should not equally be true of all forms of collaboration. Not all hidden agendas will have a detrimental effect and where a hidden agenda is found to be working in favour of a collaboration, no action is necessary. However, where less favourable hidden agendas are suspected then these need to be addressed immediately by whatever means appropriate.

Hidden agenda are, by nature, not easy to detect and as such this constitutes one area where the prior collaborative experience of the Project Manager and other key personnel will be particularly useful. Some typical examples of hidden agenda might include:

- An interest in obtaining public funds only (to leverage their own product development for example), with *no serious intentions to contribute to the collaboration.*

- An interest in marketing their products to other partners, again with *no serious intentions of contributing to the collaboration.*

- Collaborating with the specific intention of using the information shared and knowledge generated to further their own organisation's competitive advantage *at the expense of other partners.*

- Collaborating with the specific intention of undermining one of the other partners in some way.

Other important factors to be aware of include circumstances which, for whatever reason, mean that the successful or early completion of the project is not in the best interests of one of the partners. These circumstances may be financial or may arise because of an unfortunate "loop-hole" in national public funding policy. The latter has occurred in pan-European collaborations.

Note: *The* ***suspicion*** *that one of the partners harbours a hidden agenda, alone, can be enough to inflict serious damage on a collaboration. Whether or not there are sufficient grounds for suspicion, such issues must be resolved quickly in order to restore trust among the partners.*

5.3.4 Complementary Aims

Closely linked to the issue of strategic intent is that of having a "shared vision" among partners as to what the outcome of the collaboration will be [5]. However, a shared goal is not necessarily the same as shared objectives [6]. While it is possible for partners to share an *ultimate goal*, the specific *objectives* of each partner will vary and it is important that these objectives are complementary and can therefore be harmonised. For example, partners may agree on a shared vision involving a new way of producing cars more cheaply, but the objectives of individual partners could vary considerably. Some may aim to produce specific parts of the car more cheaply, or to develop a new manufacturing process which would have other benefits besides cheaper component manufacture. Others however, may focus on exploiting an opportunity to apply learning generated from the project to other products, sectors or markets.

The key is to ensure that the aims of individual partners do not conflict in a way which might prove detrimental to the project. Therefore, the collaboration should avoid situations in which the aims of one partner could result in the competitive position of another being undermined. Similarly, a collaboration should avoid involving partners whose aims are so similar that they are likely to reach a situation in which they become direct competitors.

5.3.5 Senior Management Commitment

Again this issue is closely linked to strategic intent in that a collaboration that is deemed of significant strategic importance to a partner, is more likely to have the attention of that company's senior management. Senior management commitment is essential since without it the collaboration is less likely to enjoy the commitment or attention of middle and lower level management, and tasks assigned to that partner are more likely to be given a low priority.

Establishing strategic importance is one way of determining the level of senior management commitment. Another is to invite a member of senior management to represent their organisation on the collaboration's Steering Committee. The Steering Committee has the essential duty of overseeing policy and the direction of the project. As such therefore, it represents a good opportunity to ensure that each partner enjoys maximum strategic benefit from the collaboration. A reluctance to participate could be an indicator of questionable commitment on the part of senior management.

5.3.6 Stability of the Company

Corporate instability is an issue which is more commonly associated with SMEs (small and medium sized enterprises) since such companies are particularly vulnerable to closure, take-over or sudden changes in business strategy. However, large companies too are increasingly subject to mergers, take-overs, financial difficulties and restructuring. Where recent instability or major changes are apparent in a partner, their behaviour as collaboration partners is likely to be far less predictable. In particular, it is likely that senior management and personnel assigned to the collaboration are likely to be distracted by issues within their own organisation and are unlikely to be able to afford the collaboration the degree of attention required. The role of such companies within the project must therefore be considered with particular care in order to protect the wider interests of the collaboration as a whole. One approach may be to assign the organisation a peripheral role with regard to the project work, and where necessary assign a researcher to work closely with that organisation in order to ensure that the collaboration obtains the knowledge and assistance it requires. Care must also be taken in such situations to ensure that the partner is kept informed of developments and progress.

5.3.7 The Collaboration Agreement

The terms of the collaboration agreement are extremely important. If the terms are not clearly understood or agreed, there is a high likelihood of problems occurring later on in the project. Such problems, when they arise, can be extremely damaging to trust and relations among partners, as well as having the unwelcome effect of distracting attention away from the R&D work being pursued. The terms of a draft collaborative agreement should be available at the earliest possible stage for partners and prospective partners to consider.

Agreements regarding IPR (Intellectual Property Rights) in particular, can be a source of considerable problems if not properly resolved at the outset. Though organisations will tend to have their own perspectives on IPR and how it should be handled, the basic approach of foreground IPR being owned by the partner responsible for its generation and made available to other partners on the basis of a non-exclusive royalties-free license, is currently favoured. These are the provisions made by the standard IPR agreement for European research programmes.

5.3.8 Collaboration Track Record

Where your organisation has no prior experience of working with a partner, it may be possible to establish that company's "track record" as a collaborator through previous partners elsewhere. Where prior permission is given to contact previous partners, enquiries can be made as to the partner's contribution to previous collaborations and general views about their behaviour as collaborators.

However, it is essential that any background information regarding previous collaborations and the circumstances of the partner at that time, be taken into consideration. For example, a period of instability within the partner company at the time of the earlier collaboration, may have affected the company's performance as a collaborator, thus leaving a poor impression. Therefore care must be taken in interpreting the views of others regarding a partner's previous track record.

5.3.9 Appropriate R&D Capability

The importance of this factor will depend on the nature of the project and the specific role that each partner is expected to play within it. Difficulties will arise where a partner which has no in-house R&D capability of its own, is required to actively involve itself in a collaborative R&D project that has a strong research emphasis. In such circumstances it would be advisable to examine the R&D capabilities of a partner more carefully. Clearly however, where a partner is expected to contribute no more than resource support or occasional technical support, the R&D capability of that partner will most likely be irrelevant (Section 1).

5.3.10 Setting-up Communications Channels

Communication is an essential success factor in collaborations for a number of reasons. Among partners, effective communications will help maintain commitment, interest and enthusiasm for the project. Carefully defined communications channels can also maximise the take-up of research results and other project outputs by ensuring that the information reaches all relevant and interested parties within each of the partner organisations.

This will entail identifying interested parties and maintaining contact with them throughout the project, preferably through the company's designated representative on the project team. Unless an active attempt is made by the Project Team to identify these interested parties, within large companies in particular, the information is unlikely to be disseminated beyond a particular department and may not necessarily be reaching the departments which could make the best use of it.

Expressions of interest from other areas within an organisation can also be regarded as a positive indication that the company is likely to view the project as important and beneficial. As such therefore, wider interest in the project can be regarding as an indicator that the partner is committed to the success of the project.

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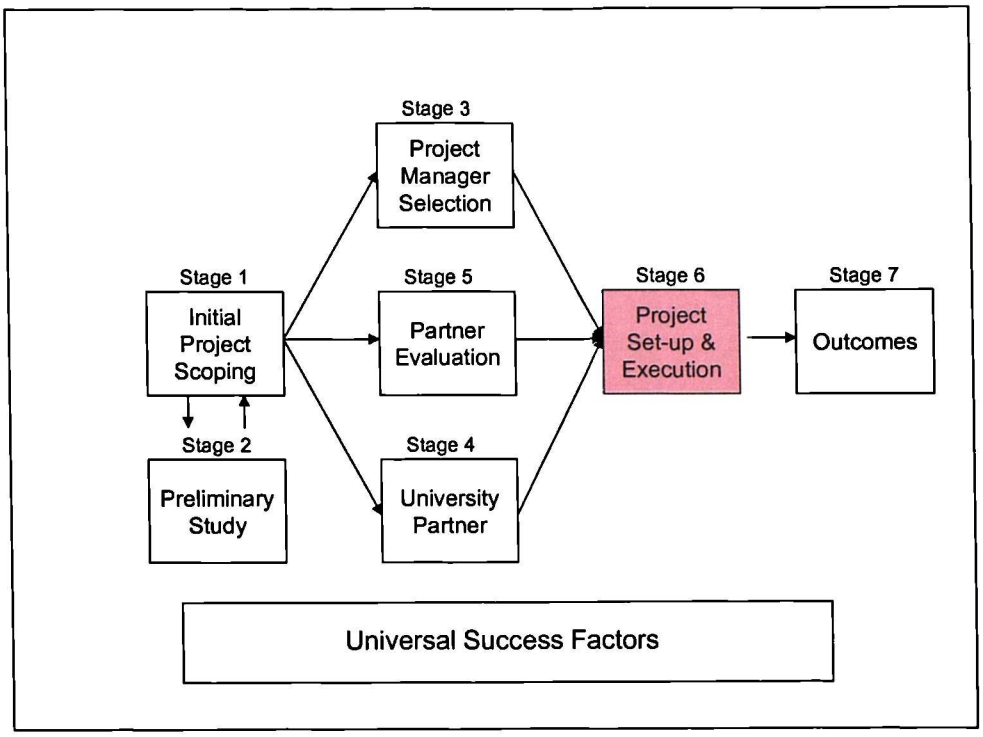
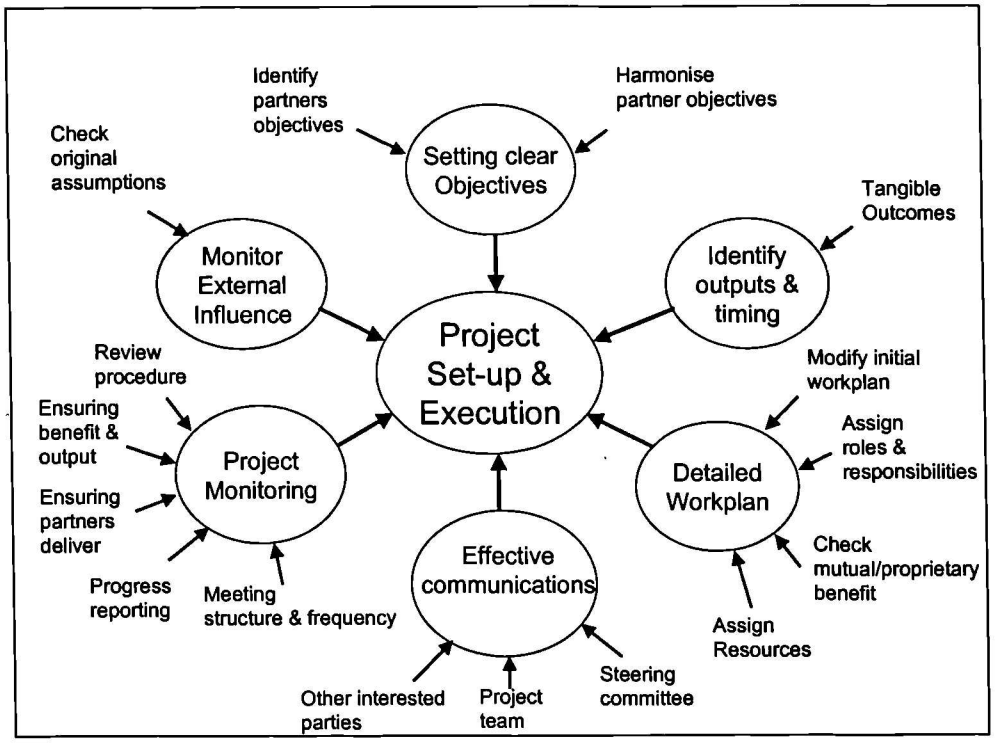
Stage 6

Project Set-up & Execution

6. Project Set-up & Execution





6.1 Introduction

With any project, careful consideration must be given to how it will be set-up and run. Such considerations become all the more critical for collaborative projects where the involvement of a number of organisations obliges the Project Manager to take into account the specific objectives and desired outcomes of all the partners. Further, the activities of all partners must be organised and monitored in such a way as to make efficient use of time and resource. The issues addressed at this stage of the Framework are typical of the management considerations made regarding any project. However, these issues are considered specifically in the context of collaborative R&D projects and where appropriate, make specific recommendations in light of the particular needs of this kind of arrangement.

6.2 Setting Clear Objectives

Setting clear objectives is essential to the success of any project. In the context of collaborative projects achieving this is made all the more difficult by the need to identify the specific objectives of each of the partners, and take them into consideration in planning the project. Furthermore, simple aggregation of partners' objectives is not enough. In attempting to meet an aggregation of all of the objectives identified, the project is likely to appear overly complex to any one individual partner involved [1]. It is also unlikely that the project will succeed in satisfactorily meeting all of these objectives since to do so may force the project to take too broad a focus. In such circumstances partners may become frustrated and terminate their support for the project.

It is therefore essential that the objectives of all partners are *harmonised* to produce a clearly defined, focused set of objectives that satisfy all partners. In this context, *harmonising* implies that any conflicting or contradictory goals have been resolved whilst still ensuring that the participants are satisfied that the project will meet their needs.

Important Note: *This process of harmonising goals will, of necessity, take a considerable amount of time. Failure to commit the time required to complete this process satisfactorily will result in problems later on. The project will appear overly complex, unfocused, too broad, slow to make meaningful progress and some partners may, at times, feel that their particular interests are being neglected.*

6.3 Identify Required Project Outputs

Identifying the outputs required from the project is an equally important factor in ensuring that the project will meet the needs of its partners. The *Project Outputs Questionnaire* (Q-4) can be used to identify which of the project's intended outcomes each partner considers to be most important, and to identify any other outputs that the partners would like to see. Further, the questionnaire can be used to devise a timing plan for the achievement of each planned output.

The timely achievement of *tangible* outputs from the project is particularly important to industrial partners, who may require early results to justify the decision to invest in the project. In other cases, the timely achievement of a specific project outcome may greatly enhance competitive advantage. Furthermore, the achievement of tangible outputs can have a marked positive effect on industrial partners' perceptions of project progress and can enhance interest, commitment and enthusiasm for the work.

The timing of the achievement of project outputs constitutes a major element of the so-called "cultural gap" between academia and industry. The generally more long-term perspective of university partners means that researchers will tend to plan to deliver research results only at the end of the project, with the result that many industrial partners may become frustrated and ultimately lose interest in the work. Careful planning of project outputs can overcome this fundamental difference in perspective. While the ultimate research result may necessarily only be realised at the end of the project, it is often possible to plan for the achievement of smaller, but nonetheless valuable outputs, early on in the project and at stages throughout the project's duration. While such measures may require that the project include some additional features, features which the academic researchers might consider unnecessary to the main research goal, the academic team are nonetheless likely to benefit. If the industrial partners are satisfied that tangible progress is being made, they will be more likely to allow the academic team greater latitude with regard to what is researched and to what depth.

Furthermore, it may be in the best interests of the project overall to include project outputs which will provide industrial partners with some evidence that the project is worthy of the investment and attention it is receiving [2]. Therefore, where possible, it is recommended that the delivery of project outputs be planned in such a way as to provide industrial partners with a steady stream of results (which need only be small, but with clear added value) throughout the project.

Important Note: *Tangible outcomes early on and, where possible, at stages throughout the project greatly enhance industrial partners' confidence and help to maintain partner interest and commitment.*

6.4 The Workplan

Developing a project workplan is an essential element of project management, and is one which is no less important in the context of collaborative projects. In particular, the need for a *clearly defined and mutually agreed project plan, clearly defined project milestones, realistic aims* and the provision of *adequate resources* have been found to be important success factors in collaboration management [3-4].

The issue of realistic aims is particularly important since it has been shown that enthusiasm in the early stages of a collaborative project can lead to a tendency to "over-promise", or "over-sell" what the project is likely to achieve [4]. Care must therefore be taken to ensure that partners' expectations regarding the likely outcomes of the project are not unrealistically high. A carefully developed workplan, outlining the activities required, should provide partners with a realistic view of what is possible in the time and with the resources available. Aside from this, two other considerations regarding the development of the workplan, in the context of collaborative projects, warrant particular attention.

Important Note: *A Workplan is essential in determining what can realistically be achieved with the resources and skills available, in the time available.*

6.4.1 Assigning Clear Roles & Responsibilities

In a collaborative project which spans organisational boundaries, it is important to clearly define what role each partner is expected to play within the project and to assign definite tasks and responsibilities to each partner. In the absence of any formal lines of authority and responsibility such provisions are essential to ensure that the efforts of all partners are properly co-ordinated and that each partner is clear as to what is expected of them.

Clearly the absence of any formal lines of authority emphasises the need to involve only committed partners in the collaboration since the partners are not obliged to do what is asked of them and the Project Manager must rely heavily on trust. However, by assigning specific tasks, roles and responsibilities to each individual partner, the Project Manager is at least provided with a means of monitoring project progress and the performance of partners in delivering as expected.

Important Note: *The assignment of clear roles and responsibilities is essential to overcome a lack of formal lines of authority and to provide the Project Manager with a means of monitoring partners (to ensure that they are delivering as required).*

6.4.2 Ensuring Mutual & Proprietary Benefit

An important aspect of ensuring that partners perceive a collaborative project as successful and that each partner remains committed to the project throughout, is that of ensuring that all partners benefit from the project to an adequate extent. Two essential types of benefit need to be taken into account in collaborative projects - the degree of "mutual" and "proprietary" benefit.

The achievement of *mutual* benefit implies equality of benefit, whereby all partners consider that the benefits of the project are evenly distributed among all parties. Failure to achieve mutual benefit will leave some partners with the impression that they are being unfavourably treated. Strained relations between partners is the likely result.

Proprietary benefit implies that each partner realises a degree of "selfish proprietary gain" from the project, proportionate to their investment in it. In developing the initial project scope and later, the detailed project workplan, the extent of support required from each partner will have become clear. It is important to ensure that based on this information, each partner realises a favourable benefit:investment ratio, i.e. each partner is getting *value for money* from the project. Where partners do not perceive that they are being adequately rewarded by the project, they are likely to merely feign commitment to it from then on. The project will inevitably suffer as a result.

Important Note: *Achieving "mutual" and "proprietary" benefit for all partners is essential to maintaining the interest and commitment of those partners.*

6.5 Effective Communications Channels

Three levels of communication have been identified as significant in the context of collaborative R&D projects. Each is briefly outlined below.

6.5.1 The Steering Committee

Senior management commitment is a key success factor for collaborative projects. Setting-up a Steering Committee therefore provides senior management members from the collaboration partners with a forum for the discussion of policy and the direction of the project. Some general guidelines regarding the function of the Steering Committee include [5]:

- Providing direction and support
- Measuring progress against some mutually agreed upon standards
- Putting continued pressure on the collaboration in the form of support, planning and the expectations for performance
- Identifying and solving problems in the event of unforeseen difficulties, needed resources, etc.

Generally, successful Steering Committees confine their interest to policy guidance and the resolution of difficult issues that could threaten the basic objectives and direction of the project. They avoid involvement in the "fine-tuning" of daily technical details, allowing the Project Manager to run the project under its policy direction [1].

It has been suggested that, in the context of international collaborations, the efficacy of such committees greatly depends on the selection of appropriate individuals to represent their organisations. Members who are:

- Inexperienced with regard to collaborative projects, or
- Are philosophically suspicious of transferring technology to foreign partners

could undermine the effectiveness of the Steering Committee [1]. Clearly, such issues correspondingly apply in any collaborative arrangement. As such therefore, a partner's choice of senior management member to represent them should be considered carefully.

6.5.2 The Project Team

The individual selected by each partner to represent their organisation on the Project Team also needs careful consideration. The skills and experience of the individual should reflect the role that each partner is expected to play within the project. Concern should be expressed where the individual put forward has substantially different skills and experience to those needed to fulfil that role. For example, where a technical role is envisaged for a particular partner, the selection of a member of the sales department as the representative, either suggests that the partner has misunderstood the nature of the support required, or is indicative of another agenda at work, e.g. the organisation is predominantly concerned with the opportunity to sell their existing products to the other partners, and not with contributing to the work.

6.5.3 Wider Communications Networks

In large organisations in particular, it can be difficult to ensure that the research results generated by a collaborative R&D project are reaching the areas of the partner organisations which will be able to make best use of it. To this end, it is recommended that Project Managers encourage the partner companies to identify other departments or teams within their organisations who are likely to be interested in the research results.

Therefore, at this stage, a network of contacts can be set-up, based on the contact information collected through the partner representatives on the Project Team. Further, by asking each of the interested parties identified to fill-in a *Project Outputs Questionnaire,* information can be collected regarding their particular interests with respect to the proposed project outcomes, the form in which they would like to receive the results of the work and a preferred means of general communication, e.g. telephone, fax or e-mail.

With regard to any university partners involved, it may also be useful to assemble a list of contact details for individuals or teams with areas of expertise relevant to the project, in order that the partners can obtain advice or additional help, should they need it.

Important Note: *The Project Outputs Questionnaire is based on the work of M. Hobday & H. Rush regarding User Needs Analysis, reported in Industry & Higher Education, April, 1997, p96-100.*

6.6 Project Monitoring

Essentially, the main mechanism for monitoring project progress will be through the workplan, which the Project Manager may use to trace the performance of the participants in completing assigned tasks and activities, and achieving agreed goals within agreed timescales. It should be noted that some flexibility is needed on the part of the Project Manager with regard to the meeting of goals and timescales. R&D projects in particular, are likely to encounter unforeseen problems or to make unexpected discoveries which might justify a change in the direction of the project. Therefore, the emphasis is on meeting *agreed* goals and timescales and not on meeting the *originally agreed* goals and timescales.

However, the importance of flexibility in collaborations and in R&D projects, should not be treated as sufficient reason for unmanaged project drift. Where problems or promising opportunities occur, the issues and implications of change should be thoroughly discussed among the partners. Such changes should therefore be the product of a deliberate and considered decision-making process, rather than an uncontrolled drift from the agreed plan.

This central aspect of project monitoring aside, consideration also needs to be given to the structure of the project monitoring activity.

6.6.1 Project Meetings - Structure & Frequency

Project meetings are defined here as meetings involving members of the Project Team and will not generally involve members of the Steering Committee (communication with the Steering Committee would generally be the responsibility of the Project Manager). Depending on the size of the project, there may also be separate Work Package meetings, attended only by members involved with a specific Work Package.

The purpose of the meetings should be to brief team members on project progress and discuss findings, problems and the next steps to be taken. It is suggested that lengthy project meetings in which team members are all obliged to make formal presentations on progress, can be counter-productive. Where possible, team members should be encouraged to communicate detailed progress and specific problems with the partners concerned on an informal basis, and that only the highlights should be reported formally at project meetings. The Project Manager and Lead Researcher should be kept informed throughout, particularly when key decisions need to be made with wider implications for the rest of the project.

It is also suggested that the frequency of the meetings should vary depending on how much progress there is to report. Where partners have to travel long distances to attend Project Meetings, it is especially important to ensure that meetings are only called when there is sufficient progress to report or when there are important issues to discuss. It is important that communication in

whatever form is relevant. Poor quality or unnecessary communication merely serves to undermine the credibility of the whole system [6].

6.6.2 Project Reporting

It is suggested that project reporting should take two forms: progress briefing reports and internal (for partners only) research reports. Progress briefing reports could accompany the formal minutes of project meetings, issued by the Project Manager, and would be designed to provide all interested parties within the partner organisations and university departments, with a brief summary of progress to date. Since such reports will tend to be issued at regular intervals, in order to maintain confidence among the industrial partners in particular, it is suggested that such reports should be kept brief, in a news bulletin style, for example. Given that such reports may be circulated among parties who have an interest in the work but are not directly involved in it, the reporting style used must be informative and should not assume that the reader has intimate knowledge of the project.

In contrast, the internal research reports should be issued on a far less frequent basis, e.g. annually, and should incorporate a detailed reporting of the work done over the period, a presentation of the results, analysis and discussion of the results and report on the main learning points, conclusions and the implications of the results for the project and for future work. The report should be an academic document and should be considered a valuable project outcome.

This two-part reporting approach is suggested as a means of reducing the levels of unnecessary bureaucracy that can occur in collaborative projects. Such an approach should aim to avoid situations arising in which academic researchers are obliged to consume an inordinate amount of valuable research time writing reports that the industrial partners are unlikely to have time to read, or consider valuable.

6.6.3 The Review Procedure

The rapidly changing technological and commercial environment means that it would be unreasonable to assume that the strategic position of the industrial partners will not change over the course of a collaborative project. Given the inherent uncertainties regarding the likely outcomes of an R&D project, it is also likely that a project will not proceed in the direction originally intended. As a result of such changes, certain partners may find that the project is no longer serving their interests adequately enough to warrant their continued support. Where this occurs it is important that the situation be addressed immediately, leading to a prompt resolution.

Where partners unwittingly find themselves in an unfavourable position with regard to the collaboration, failure to address the problem will increasingly frustrate the organisations involved. It is therefore suggested that

collaborative projects incorporate a review procedure, which is triggered whenever the project undergoes a significant change in direction or a partner's business strategy changes in a way which directly affects their involvement in the project. Partners should be given the opportunity at this stage, with the consent of the other partners, to withdraw from the project. If the partner prefers to remain involved, the Project Team will need to help that partner define a new role within the project which will restore realisable benefit to acceptable levels.

Important Note: *An immediate project review should be conducted where the project undergoes a significant change in direction, in order to assess the position of the partners. Partners who cease to benefit from a project as a result of a change in project direction, will quickly become frustrated unless action is taken to resolve the situation.*

6.7 Monitor External Influence

Once involved in the day-to-day detail of a collaborative R&D project, it is easy to lose sight of changes in the external environment, changes which may have important implications for the research being conducted. Factors such as new legislation, patent filings and the activities of competitors in the field, for example, could result in the need for a significant change in the direction of the work being undertaken, or at worst, could render the work obsolete.

One way to ensure the continuous monitoring of external change is to involve a "gatekeeper" in the project. "Gatekeeper" is the term given to an individual within an organisation who undertakes the role of monitoring such changes. In the context of a single organisation, the gatekeeper will seek relevant information from other departments across the organisation, as well as from external sources, thereby actively working to create links between departments and encourage information sharing [7]. Therefore, where such individuals exist within the partner organisations, it would be useful to maintain close contact with them. Where such gatekeepers are not available, it would be advantageous to generate links with departments within the partner organisations, best placed to provide up to date information regarding the external environment, e.g. the marketing and legal departments.

References & Further Reading

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[3] Bruce, M. *et al*, Success factors for Collaborative Product Development: A Study of Suppliers of Information and Communication Technology, *R&D Management*, 1995, **25(1)**, p33-44.

[4] Spekman, R.E. *et al*, Creating Strategic Alliances which Endure, *Long Range Planning*, 1996, **29(3)**, p346-357.

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[6] CEST, The Management of Technological Collaboration, *report by the Science Policy Research Unit (SPRU), University of Sussex for the Centre for Exploitation of Science and Technology (CEST)*, 1991.

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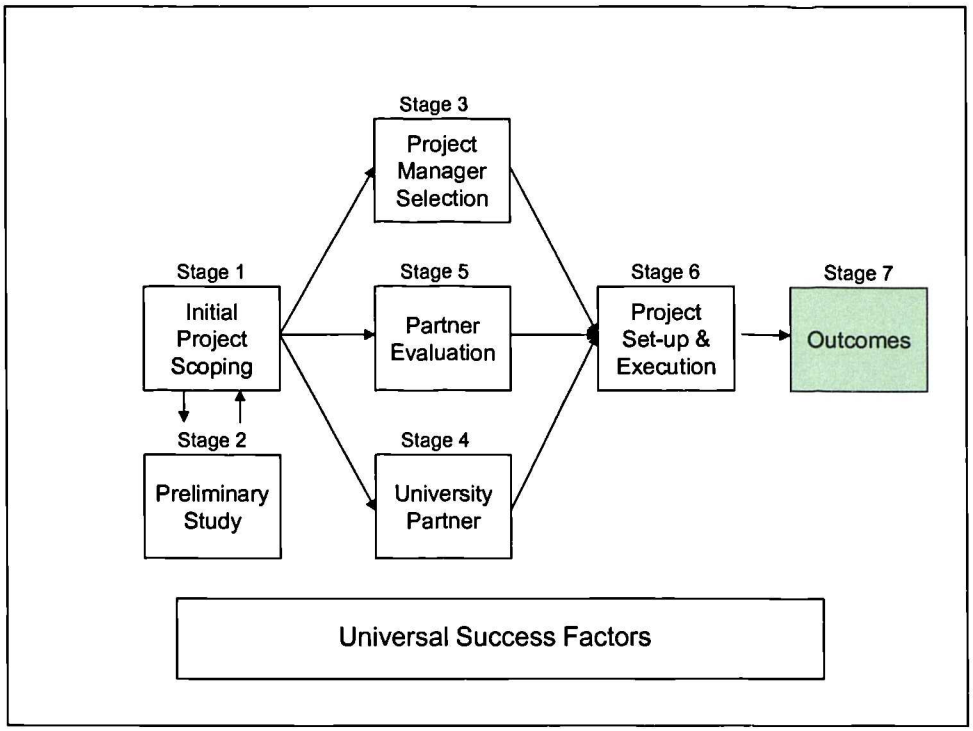
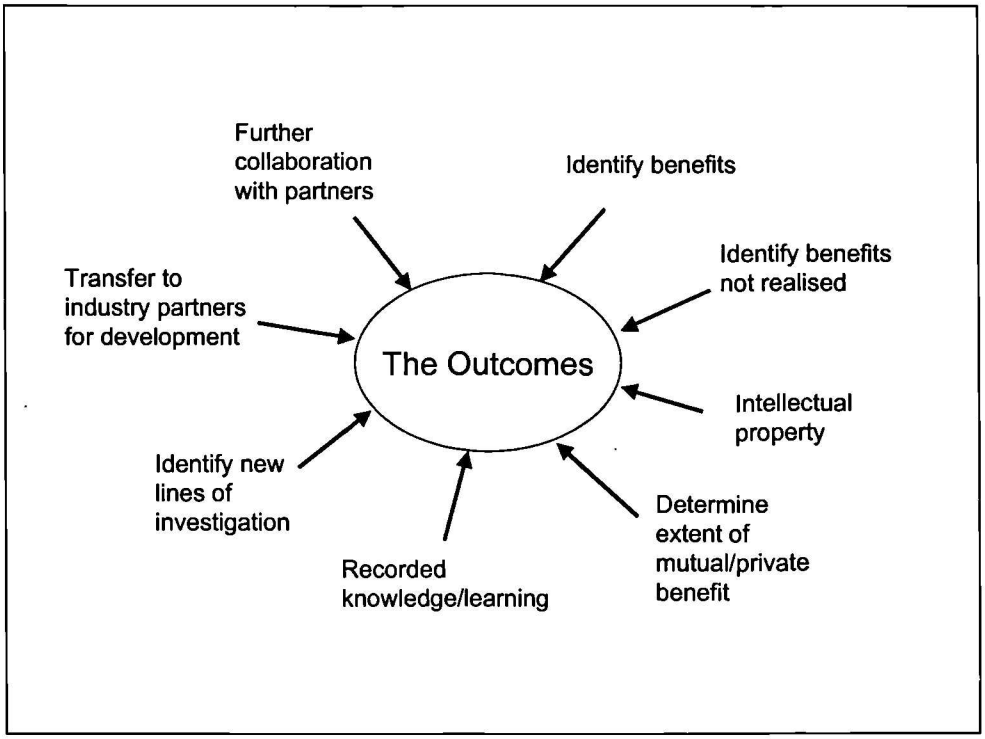
Stage 7

The Outcomes

7. Outcomes


Stage 3
Project Manager Selection
Stage 1
Initial Project Scoping
Stage 5
Partner Evaluation
Stage 6
Project Set-up & Execution
Stage 7
Outcomes
Stage 2
Preliminary Study
Stage 4
University Partner
Universal Success Factors


Further collaboration with partners
Identify benefits
Identify benefits not realised
Transfer to industry partners for development
The Outcomes
Intellectual property
Identify new lines of investigation
Recorded knowledge/learning
Determine extent of mutual/private benefit

7.1 Introduction

Organisations collaborate with the expectation that a specific set of outcomes will be achieved. Therefore, the extent to which those desired outcomes are achieved is central to how partners perceive the success of the project. The Outcomes stage of the Framework prompts the user to identify what benefits/outputs have been realised through the collaboration and to assess whether or not these were what was expected and whether or not partners are satisfied with what has been achieved. The Framework also prompts the user to consider a number of other possible outcomes which whilst valuable, can tend to be overlooked.

Important Note: *The process of assessing project outcomes can be applied at any point throughout a project's duration and may be followed up by later re-assessments as a means of monitoring progress over time.*

In fact, this is to be recommended as it provides the Project Manager with an additional source of information that can be used to assess the status of the project. The *Outcomes Questionnaire* has been developed as a tool to aid the Project Manager in assessing progress and as a mechanism for collecting partner's views in a standardised way, for ease of analysis. The Questionnaire is accompanied by a set of *Evaluator's Notes* to aid analysis.

For a number of the questions in the Questionnaire, the *Evaluator's Notes* advise the Project Manager to report partner's responses back to the Project Team itself and to the Steering Committee. This exercise is designed to ensure that the outcomes of the project are properly acknowledged and clearly communicated. In the midst of the activity within a project, the extent of achievements made across the project are not always clearly evident to individual participants. An overview of achievements made will also remind participants of the overall objective toward which they are all working. By keeping the Steering Committee informed of developments, interest and commitment to the project will be maintained and the fit between strategy and actual results will be more self-evident.

An overview of the issues addressed by the *Outcomes* stage is given below.

7.2 Identify Benefits/Outputs Achieved

Identifying the benefits that have arisen from the project provides a measure of performance, a means of assessing project progress and, through the *Outcomes Questionnaire*, also provides a measure of *proprietary* benefit with respect to each of the partners. Through this assessment, the benefits/outputs achieved can be compared against what was originally anticipated, providing important feedback as to the status and direction of the project. Also, the extent to which partners are achieving real benefit will strongly influence the perceived success of the project. Therefore, the assessment will also provide a early warning sign if partners are concerned that their investment is not being adequately rewarded.

The benefits listed by partners will vary widely as a result of differing areas of interest. It is therefore important for the Project Manager to make an overall assessment as to whether or not the project is achieving its intended goals. The benefits achieved are an important measure of project success, but the type of benefits that might be expected will vary with a given collaboration. Therefore, the Project Manager must exercise judgement in determining how appropriate the benefits listed are to the overall aims of the project.

7.3 Identify Benefits/Outputs Not Achieved

Identifying benefits/outputs that were anticipated, but were not in fact realised, is equally important in assessing progress. However, failure to achieve certain anticipated outputs is not necessarily an indicator that the project itself is failing. Therefore, an outcome that has not been achieved for a specific reason, e.g. because a change in project direction or focus has rendered that particular output as inappropriate or unnecessary, is of no immediate concern. Outputs which remain relevant but have not occurred as anticipated, do however warrant further investigation.

7.4 Mutual/Proprietary Benefit

Achieving mutual and proprietary benefit is important in maintaining a good working relationship among partners and ensuring that the partners perceive the collaboration as having been successful. It is likely that where concerns exist, partners will ensure that the Project Manager is made aware of it, either directly or through the *Outcomes Questionnaire*. Where a university partner is involved, the Project Manager should pay particular attention to whether or not the benefits accruing to the university and to the industrial partners are equally balanced. In some cases, researchers may place too much emphasis on the academic issues, in others industrial partners may exert too much influence, with the result that researchers are unable to devote adequate time to writing papers based on the work, or to conducting more in-depth investigations where the project warrants it. By working closely with the Lead Researcher to harmonise the needs of the two parties, it is possible to achieve a workable compromise that satisfies all parties.

7.5 Intellectual Property (IP)

Intellectual Property as a result of collaboration is a tangible outcome which is highly valued by industry and increasing also by universities. The generation of patents, for example, also infer that a degree of innovation has been achieved as a result of the collaboration – a measure of success that would satisfy government funding bodies.

7.6 New Knowledge/Learning

When considering the benefits and outputs from a collaborative project, greater attention tends to be given to the more tangible outcomes such as IP (intellectual property), number of papers published and actual new product, process or technological developments. In contrast, new knowledge and learning generated through the work tends to be overlooked and is rarely properly recorded or disseminated for the benefit of future projects or other project teams.

There are a number of ways in which this knowledge and learning can be captured and disseminated. A certain amount will be published in the public domain in academic journals. However, more commercially sensitive items of technological knowledge and learning could be disseminated through an internal report (where necessary this could be distributed in summary form) or through formal presentations, seminars and depending on the nature of the learning, through workshops.

> ***Important Note:*** *Technological developments constitute only part of what is likely to be learned from a collaborative project. Learning from the experience of collaboration should, in itself, be valued and disseminated since it is only through learning from the mistakes of past collaborations that future collaborations can be improved.*

Collaborative learning may also be disseminated through reports, presentations or workshops, or alternatively through the development of procedures and guidelines designed to aid other Project Managers.

7.7 Identify New Lines of Investigation & Continuing Collaboration with the Partners

Possible new lines of investigation identified as a result of a current project, represent a valuable outcome in that it suggests that the benefits of the current project can be further built upon, thereby enhancing the value of the current work whilst also providing a direction for the future. Communicating such findings to the Steering Committee may enhance senior management interest in the work. Also, if the interest in such new lines of investigation is shared by other partners, there is the possibility of a continuation of the work with the same partners.

Maintaining a collaboration with the same partners beyond the original project has a number of benefits. Project set-up and management is considerably simplified since the meeting and reporting structure, and channels of communications are already in place. Also, the partners will already be familiar with each other, a style of working will have evolved with which all partners are comfortable and the probability of *Goodwill Trust* developing among partners will be considerably enhanced (Section 8.2).

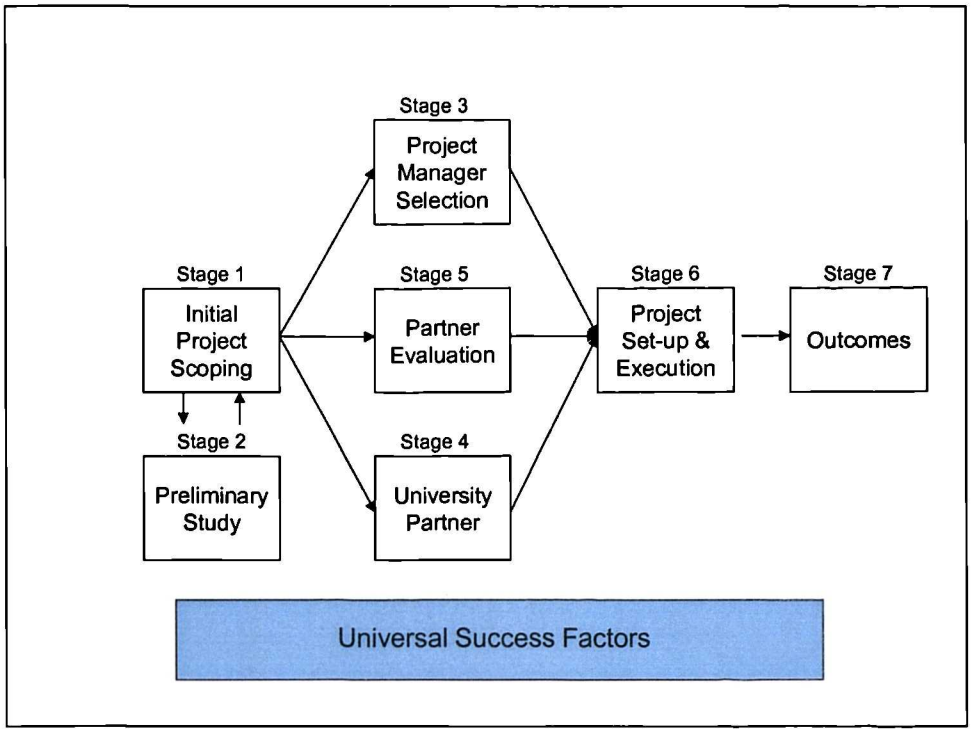
7.8 Technology Transfer to Industry

In many collaborative R&D projects involving universities, transferring a newly developed technology to one of the industrial partners for further development and implementation will be the ultimate outcome. Clearly, it is important that such developments be transferred to industry as soon as it is practical to do so in order to maximise competitive advantage. However, it should be recognised that the best mechanism for the transfer of technology is through people.

Therefore, it may be necessary to second members of the Project Team, e.g. the academic researchers, to the industrial partner to ensure that the transfer takes place efficiently and successfully. Secondment could have spin-off benefits for the researchers who will benefit from the transfer experience, additional industrial experience and in the case of student researchers, there is the possibility of recruitment. Thus, there are wider benefits to be taken into account in assessing the achievements of a collaborative project.

Universal Success Factors

8. Universal Success Factors



8.1 Introduction

The *Universal Success Factors* are those factors which, while critical to the success of a collaboration, cannot be confined to any one area of the model. They are the global factors which must be a characteristic of the collaboration as a whole. The universal success factors are:

Mutual trust
Commitment
Flexibility
Continuity
Good personal relations
Learning
Leadership
Collaboration champion

Because these factors do not fit into a specific area or stage of the model, the Framework does not test for them as a specific group. However, where possible, the questionnaires and checklists make at least indirect reference to these success factors. In this way, the Framework is designed to create conditions within a collaboration which favour these more universal factors.

It is important that collaborators be made aware of these particular success factors and their influence on the success of collaborations. Therefore, this section of the Handbook provides a brief summary of the role of each of the universal success factors in collaboration success. It is hoped that, by providing an awareness of these factors, Project Managers and collaborators will actively seek to provide their own conditions for success.

8.2 Mutual Trust

Mutual trust is widely recognised as a key success factor in collaborations [1-6]. However, trust is not easily achieved in a commercial environment, between organisations who will not necessarily be familiar with each other. Trust requires a firm base on which to develop from the very beginning. The Project Manager must take a leading role in creating such conditions by treating all partners and researchers equally and fairly. Trust requires frank communication, meeting commitments and informing people as soon as problems arise. The discovery that certain items of information have been withheld will invite the suspicion that there may be much more that the partners are not being told. Once an atmosphere of mistrust has been established, it will be extremely difficult to overcome.

The free disclosure of information necessary to engender a sense of trust among partners, can be difficult to achieve in practice, particularly in today's highly competitive climate. To this end, some work that has been done in the area of developing trust among collaborative partners, which provides a useful model for the stage-by-stage achievement of trust. Figure 6 presents this model which has been developed by the author, from the work of Davenport *et al* [6].

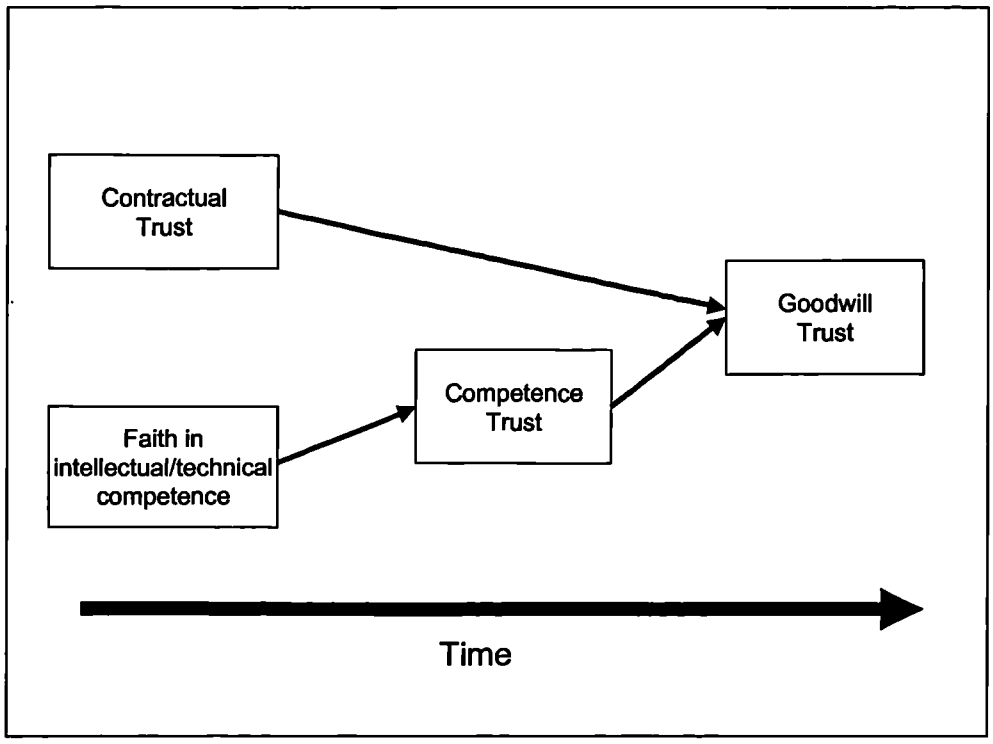


Figure 6 A Framework for the Development of Trust [6]

The model represents the hypothesis that *Goodwill Trust* will develop, with time, on the basis of two other forms of trust - *Contractual Trust* and *Competence Trust*. *Goodwill Trust* in the context of collaboration is defined as the embodiment of mutual commitment to the partners in the relationship. *Contractual Trust* is defined as adherence to agreements and promises. *Competence Trust* involves expectations of ability and performance [6].

Therefore, the basis for *Contractual Trust* is provided by the collaboration agreement and any other contractual controls on project accountability that invoke action in the case of non-performance and contractual violation. Hence, it is very important to ensure that the collaboration agreement and the terms of the IPR agreement are clearly defined and acceptable to all partners, and that the Project Manager is prepared to enforce the terms of agreement, should it become necessary.

Competence Trust is largely attributed to the research organisation or university partner to a collaboration [6]. Faith in the intellectual capability of the university partner or research organisation is what is thought to initiate the development of *Competence Trust*. A university group's reputation in the field to be researched by the collaboration would therefore constitute the beginnings of *Competence Trust*. However, this reputation must then be followed up with actual evidence, based on *tangible results* [6].

Goodwill Trust can take time to develop and it is suggested that this might only occur after repeat alliances. Evidence for the evolution of *Goodwill Trust* however suggests that where it occurs, a collaboration will tend to be characterised by the replacement of cautious contracting with looser practices as partner firms build confidence in each other. The amount of time required for *Goodwill Trust* to develop suggests that in many cases, collaborations will need to rely heavily on *Contractual* and *Competence Trust* and this will require a degree of effort and commitment, from the Project Manager (in enforcing *Contractual Trust*) and the university partner (in demonstrating competence and thereby engendering *Competence Trust*).

"Goodwill Trust" is believed to evolve over time from "Contractual" and "Competence Trust". Therefore, the Project Manager must honour and enforce contractual agreements and university partners must demonstrate competence with respect to the research work.

8.3 Commitment

Commitment infers dedication to a course of action and exposure to a certain degree of risk in doing so, and this explains the importance of commitment to the success of collaborations. It is closely related to trust in so much as trust must be present, to some degree, in order for commitment to follow. Therefore again, the Project Manager must take the lead in terms of ensuring fair and equal treatment of partners and enforcing contractual agreements. Also, the inference that commitment generally involves a certain degree of risk suggests that commitment will only be maintained so long as partners perceive that the benefits are commensurate with the risk undertaken.

Commitment should be an important consideration in the evaluation of collaboration partners, since certain conditions regarding the collaboration will influence the likelihood that a given partner will offer genuine commitment to the project. The strategic importance of the project to the prospective partner, is one means of determining how committed a partner firm is likely to be. In particular, strategic importance is likely to engender senior management commitment, which in itself is credited as a factor in the success of collaborations. Closely related to strategic importance is the issue of commensurate levels of risk, whereby partners are heavily reliant on each other in working toward the achievement of a given goal. The goal will generally be of significant strategic importance, providing a substantial competitive advantage to the partners if they succeed, but at the same time would involve too high a level of risk for any one individual partner to undertake alone [7].

Therefore, there are two major elements to commitment regarding collaborations. Firstly, care must be taken to select partners, who through the nature of the collaboration and its strategic significance to them, are more likely to be committed to project success. Secondly, the Project Manager must ensure that commitment to the project is not undermined by the poor handling of contractual affairs and a lack of results and benefits commensurate with the risks borne by the partners.

Commitment infers dedication to a course of action and exposure to a certain degree of risk in doing so.

8.4 Flexibility

Flexibility is an essential factor in collaborations because of the fluid nature of the world of business. Provided that the objectives of collaboration are clear and agreed between partners, there are advantages to flexibility. Flexibility allows the project to grow organically into areas of greatest potential, rather than constraining them to pre-existing views of what is expected. The importance of flexibility is demonstrated by the fact that the outcomes of collaborations are rarely the ones that were initially expected [2].

Similarly, from the perspective of managing R&D projects flexibility is an inevitable factor of the inherent uncertainties involved. Early on in R&D projects, it is common for there to be a number of unknowns. At any point over the duration of an R&D project there is the possibility of an unexpected outcome arising which may indicate that a new direction may prove more fruitful than the original course. A decision will therefore need to be made as to whether to proceed as planned, or to pursue this new and potentially more promising direction.

However, the importance of flexibility in collaborations and in R&D projects, should not be treated as sufficient reason to neglect project planning. When developing a workplan, it is important to include as much detail as is available at the time. It is acceptable to add more detail later on as certain milestones approach and the route toward them becomes more clear. With regard to specific changes in direction, the key is to ensure that the issues are thoroughly discussed among the partners and that the resulting course of action is clearly agreed upon. Such changes should therefore be the product of a deliberate and considered decision-making process, rather than an uncontrolled drift from the agreed plan.

*"Flexibility" allows a project to grow organically into areas of greatest potential, rather than constraining them to pre-existing views of what is expected. However, flexibility should **not** be treated as sufficient reason to neglect project planning.*

8.5 Continuity

Continuity in the context of collaboration refers to the continuity of the Project Team itself. Frequent changes of personnel within the Project Team, and in particular changes of Project Manager, though to some extent inevitable, are nonetheless highly disruptive to the remaining team members. Relationships and trust at the individual rather than the organisational level, take time to rebuild with a new team member and significant time can be lost while the new member is brought "up to speed" on events leading up to their arrival. Where possible therefore, an overlap period whereby both the out-going and in-coming partner representatives attend project meetings, should be encouraged.

The effects of a Project Manager change-over tend to have a much more profound effect on a collaboration. A change of manager can significantly alter the character and openness of a collaboration. A new manager may enter the collaboration with new agendas and career aspirations. Further, new managers may perceive only limited career benefit in continuing to support the projects of their predecessors [8]. An additional problem regarding personnel changes involving any of the partner companies, is that new members are likely to have the perception that they were "dumped" with the work of a predecessor, and as such are unlikely to show any natural commitment to the project.

Clearly therefore, personnel changes can be inherently detrimental to a collaboration. While the majority of personnel changes will remain inevitable and beyond the control of collaboration managers, certain factors may reduce the tendency for personnel to actively seek re-assignment. If the project is of significant strategic importance to a company for example, and therefore has the attention of the company's senior management, then the associated prestige may encourage individuals to continue in the role assigned to them. Similarly, clear evidence that the project is succeeding in meeting its goals through the timely achievement of tangible outcomes, will minimise any pressure placed on team members to justify time spent on the project to their immediate superiors within their organisations. In this way, individual team members may feel less inclined to move on.

Finally, there is a tendency for the involvement in collaborative projects to be perceived as a non-value adding activity within organisations. Again, this view can be influenced by striving to increase the level of success in collaborations. Furthermore, involvement in collaborative projects can provide individual team members with valuable experience that can prove useful in other areas of the organisation, e.g. the ability to negotiate with other parties and practice diplomacy in dealing with important issues. Until such benefits are recognised, individuals involved in collaborative projects are unlikely to perceive their role in them as being of any significant long-term personal value.

8.6 Good Personal Relations

Good personal relationships among participants benefit a collaboration by improving the flow of information and are best achieved in an atmosphere of mutual trust and open communication. It has also been suggested that the secondment of personnel can be useful in improving relationships, by enabling key personnel to develop an understanding of the issues affecting other parties [8]. In collaborations involving academic as well as industrial partners, secondment can be a particularly effective way of resolving cultural differences, as well as being the most effective mechanism for technology transfer.

A "clash" of personalities is difficult to mitigate against, but where such an occurrence becomes evident, action must be taken to resolve the situation by assigning the individuals concerned to roles which would minimise contact between them, or if necessary by replacing certain individuals. Left unchecked, personal issues of this kind can be disruptive to the rest of the Project Team and is not conducive to an atmosphere of trust and open communication.

8.7 Long-term Learning

Partners should regard collaboration as a long-term learning process, involving learning beyond the immediate aims of the collaboration [2]. Collaboration offers the opportunity for partners to improve the way in which they integrate external sources of technology with in-house efforts, extends management experience and skills with respect to the process of collaboration and enables partners to develop a reputation as a good and fair collaborator [2].

Partners should be encouraged to value learning gained from a collaboration as an important outcome. The Project Manager can encourage this view by emphasising the value of what has been learned during the course of a collaboration and drawing attention to any potential spin-off benefits that could result from it in the future. Essentially there is little value in a collaboration where the partners do not learn anything new and even partners who had not anticipated learning new things will tend to express disappointment in a collaboration that does not yield some new learning. Conversely, where partners do feel that some learning has been achieved, the collaboration is likely to be perceived more favourably as a result.

8.8 Leadership/Collaboration Champions

Leadership and management are critical features in the success or failure of a collaboration. Whilst often considered synonymous, leadership and management are related but distinctly different. Leadership provides the vision, the drive and the motivation needed to make things happen, while management is about problem-solving and the planning and organising of resources and activities which enable the leader's vision to become a practical reality [4]. Leadership is often one of the key driving forces that enable collaborations to happen, but even once a collaboration becomes a reality, leadership remains critical. Leadership continues to provide the collaboration with vision and direction and is a major source of motivation for the Project Team.

Leadership within a collaboration is personified by the "collaboration champion", an individual who intensely believes in the purpose of the collaboration, who will support it throughout and who is passionate about its ultimate success [4]. Leadership has a particularly critical role to play in collaborations, since their are no formal lines of authority. Whereas managers generally enjoy an enforced authority over others, one of the essential qualities of leaders is that others will instinctively and willingly follow where they lead.

A Project Manager may be capable of both management and leadership roles. However, where partners are committed to the strategic value of the collaboration, the natural role of leadership lies with senior management. As such, the creation of a Steering Committee involving all of the partner organisations, provides an excellent forum from which senior managers can demonstrate their commitment to the collaboration and provide the Project Team with the vision, direction, and support required.

"Leadership" within a collaboration is personified by the "collaboration champion", an individual who intensely believes in the purpose of the collaboration, who will support it throughout and who is passionate about its ultimate success

References & Further Reading

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[3] Harrigan, K.R., Managing for Joint Venture Success, *Lexington*, 1986, 1st Edition, Ch.8.

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Measuring Project Success

9. Measuring Project Success

This Framework is aimed at increasing the probability that a collaborative R&D project will succeed, by helping managers to manage collaborations more effectively. However, the Framework does not explicitly define "success". The reason for this is that there is no universal definition of "success" in the context of collaborations. The range of partners' circumstances and their expectations and experiences of collaboration, will be so variable for any given project that the formulation of uniform definitions of success and failure is impractical [1].

Furthermore, projects can be successful in one or a range of dimensions and yet fail in other respects. A project may therefore prove modestly successful *technologically* and yet fail in the *exploitation* of those technological successes. In other circumstances, a project may be judged a failure on one specific dimension, despite some notable successes on other dimensions. For example, a project may achieve *technological* success and yet be judged a failure because some of the partners felt that the benefits realised were not commensurate with their investment, i.e. *value for money* was not achieved [2].

Finally, while it is common within industry to judge project success in terms of performance in meeting the original objectives, on time and within budget, such a measure does not necessarily hold for R&D projects, or for collaborations. Failing to meet the originally agreed objectives does not necessarily mean that a collaboration was unsuccessful. Where a project is prematurely terminated for example, there can still be unexpected benefits in terms of experience and knowledge which may prove useful in other projects or the development of new products [3].

This Framework is based on a recognition that many collaborations fail to make the most of their partners, prove difficult to manage because of the complex issues involved and will be judged by partners to have failed because they do not feel that they have adequately benefited from it. As such therefore, this Framework concentrates on the people issues and on rigorous project management, on the basis that the difficulties associated with these aspects of collaboration can seriously undermine the success of a project.

However, it is not suggested that project success should be measured on the basis of people issues and project management alone. The Framework will encourage the fair and equally treatment of partners for example, but a project could still be deemed a failure if nothing technologically new results from it. Therefore, the purpose of the Framework is merely to help managers to manage collaborations more effectively. The criteria for the success of a given project, must be determined by the partners themselves. To this end,

this section provides a number of possible dimensions to success which might be considered.

- *Incremental innovation* - product/process/technology improvement
- *Radical innovation* - new product/process/technology
- New knowledge
- Meeting agreed objectives, on time and within budget
- Develop and *exploit* new technology/new knowledge
- Partner satisfaction
- Develop closer working relations with partners with a view to a more long-term collaborative R&D arrangement
- Personal growth, i.e., the degree of interest, challenge and personal development
- Completeness of project termination, i.e., the absence of problems identified as a result of the post-project audit

These are examples only, there may be many more possible dimensions.

Defining appropriate technological and/or strategic success criteria in this way will provide a project with a specific focus. However, such criteria will still need to be combined with such considerations as partner satisfaction and project management effectiveness to provide a complete assessment. Therefore, a composite approach to measuring project success is recommended, combining a small number of specific dimensions, but incorporating the essential elements of technological, strategic, project management and people factors to provide a complete evaluation of the collaboration as a whole.

The range of partners' circumstances and their expectations and experiences of collaboration, will be so variable for any given project that the formulation of uniform definitions of success and failure is impractical [1].

References & Further Reading

[1] Dodgson, M., Technological Collaborations in Industry, *Routledge*, 1993, 1st Edition, Ch. 12.

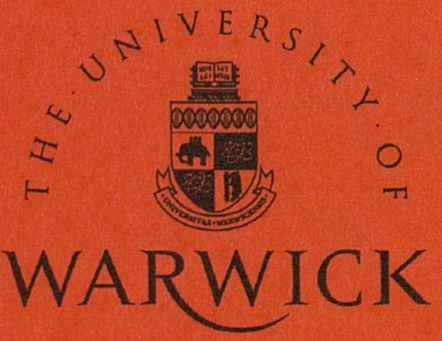
[2] Guy, K. *et al*, Evaluation of the Alvey Programme for Advanced Information Technology, *HMSO*, 1991

[3] Littler, D. *et al*, Factors Affecting the Process of Collaborative Product Development: A Study of UK Manufacturers of Information and Communications Technology Products, *Journal of Product Innovation Management*, 1995, **12**, p16-32.

10. Conclusions

This Framework has attempted to provide the collaboration practitioner with a practical guide to the effective management of collaborative R&D projects. The Framework represents a distillation of what is generally known and understood about effective collaboration management into a tool which is both useful and easy to apply for any practitioner of collaborative projects, regardless of previous experience in the field.

By applying the Framework, the practitioner should benefit from a clearer insight into the issues which discriminate a successful collaboration from a failure. Through the Collaboration Chart the Project Manager should be able to identify potential problems areas and act accordingly to resolve them. Further, the permanent record of the collaboration provided by the Collaboration Chart should help the Project Manager to evaluate project performance and identify any key learning points and areas for improvement. In the process it is hoped that the Collaboration Framework will provide a basis for continuous improvement and contribute to greater collaboration success in the future.



A Framework for the Effective Management of Collaborative R&D Projects

User Pack

Project Manager Selection Questionnaire

Section 1 - Management Skills

1. Has the proposed project manager received any formal project management training?

   Yes = 1
   No = 0

   Please write score in box ❑

2. Would you describe the proposed project manager as having:

   i Considerable project management experience **(3)**
   ii A moderate degree of project management experience **(2)**
   iii A limited amount of project management experience **(1)**
   iv No previous experience of project management **(0)**

   Please write score in box ❑

3. Has the project manager had any previous experience of managing a project of similar size, i.e. size of budget, number of personnel, level of strategic importance, to the proposed project?

   Yes = 1
   No = 0

   Please write score in box ❑

4. Would you describe the proposed project manager as having:

   i Considerable experience of managing *collaborative* projects **(3)**
   ii A moderate degree of experience of managing *collaborative* projects **(2)**
   iii A limited amount of experience of managing *collaborative* projects **(1)**
   iv No previous experience of managing *collaborative* projects **(0)**

   Please write score in box ❑

5. Has the project manager had any previous experience of managing a *collaborative* project of similar size, i.e. size of budget, number of personnel, level of strategic importance, to the proposed project?

   Yes = 2
   No = 0

   Please write score in box ❑

6. It has been stated that project managers with experience of a number of different functional areas tend to be more effective because they have an appreciation of the issues affecting other functions. Which of the following phrases best describes the proposed project manager's experience of working in functional areas other than the one in which he/she currently works, e.g. design, production, R&D, marketing, etc?

i.	Considerable multi-functional experience	**(3)**
ii.	Moderate multi-functional experience	**(2)**
iii.	Limited multi-functional experience	**(1)**
iv.	No experience of working in other functions	**(0)**

   Please write score in box ❑

7. Which phrase would best describe the proposed project manager's experience of cross-functional project teams?

i	Experienced in cross-functional project teams	**(2)**
ii.	A limited amount of experience of working in cross-functional teams	**(1)**
iii.	No experience of working in cross-functional project teams	**(0)**

   Please write score in box ❑

8. Which phrase would best describe the proposed project manager's abilities with regard to managing people?

   i. Highly respected & trusted by the majority of those who have previously worked with him/her **(3)**

   ii. Has rarely been the subject of criticism or complaint by those who have previously worked with him/her **(2)**

   iii Has been the subject of some minor criticism or complaint by those who have previously worked with him/her **(1)**

   iv Has frequently been the subject of criticism or complaint by those who have previously worked with him/her **(0)**

Please write score in box ❑

9. Which phrase would best describe the proposed project manager's abilities with regard to diplomacy?

   i. Highly skilled in the diplomatic handling of situations **(2)**

   ii. Has shown competence in the diplomatic handling of situations **(1)**

   iii Diplomacy skills are untested or in need of further development **(0)**

Please write score in box ❑

Note: *The "situations" to which Question 9 refers need not be a collaborative project. The candidate may be judged on their handling of any situation where diplomacy is required, e.g. a shop floor dispute or differences of opinion among colleagues.*

Charting the Results of Section 1

Add together the *boxed* scores for Questions 1-9. Plot the resulting score on the Collaboration Chart under "management skills".

Section 2 - Technical Awareness & R&D Experience

10. Could the proposed project manager be described as having:

    i. A technical background?

    ii. An awareness of technical issues?

If the response to either of the above is **"Yes"**, then enter **"1"** in the box below. If the response in both cases is **"No"** then enter **"0"** in the box below.

Please write score in box ❑

11. Which of the phrases listed below best describes the R&D background of the proposed project manager? *(See Guide Notes, Section 1.2)*

    i. Has R&D experience which is appropriate to the project to be undertaken **(2)**

    ii. Has R&D experience which may be helpful in the project to be undertaken **(1)**

    iii. Has no previous experience of R&D projects **(0)**

Charting the Results of Section 2

Responses to Questions 10 & 11 should be plotted separately at the appropriate points on the Chart under "technical awareness" and "R&D experience".

University Partner Questionnaire

Section 1 - The Lead Researcher

1. Do you consider the Lead Researcher to be sufficiently experienced, as an academic, to manage the activities of the Research Team?, i.e., has an appropriate background in academic research, publications and level of post-doctorate experience.

   i. Yes (2)
   ii. No, but additional support will be available (1)
   iii. No (0)

   Please write score in box ❑

2. Does the Lead Researcher have academic experience/expertise in an area which is appropriate to the project?, i.e., in an appropriate technical field.

   i. Yes (2)
   ii. No, but additional support will be available (1)
   iii. No (0)

   Please write score in box ❑

3. How would you describe the Lead Researcher's experience of supervising doctorate-level students?

   i. Has a good "track record" of success (2)
   iii. Has some experience of doctorate-level supervision (1)
   iv. Has a poor record or is inexperienced as a supervisor (0)

   Please write score in box ❑

4. Does the Lead Researcher have a level of industrial experience which is appropriate to the project's needs?

   i. Yes (6)
   ii. Has some industrial experience & appreciation of industry (3)
   iii. Has no industrial experience at all (0)

   Please write score in box ❑

5. Taking into account all other academic commitments that the Lead Researcher might have (e.g. lecturing, student supervision), does the Lead Researcher have sufficient time available to undertake the role of managing the researcher's activities effectively?

   Yes = 6
   No = 0

   Please write score in box ❑

6. How appropriate is the Lead Researcher's technical expertise with respect to the project's needs?

   i. Appropriate expertise in relevant technical field (6)
   ii. Inappropriate level or field of expertise (0)

   Please write score in box ❑

7. How would you rate the Lead Researcher's ability to organise research projects and researchers?

   i. Excellent (3)
   ii. Good (2)
   iii. Satisfactory (1)
   iv. Could be improved (0)

   Please write score in box ❑

8. Has the Lead Researcher had any previous experience of running a research project of similar size (i.e. level of research funding, number of researchers and support personnel) to the proposed project?

   Yes = 3
   No = 0

   Please write score in box ❑

9. Would you describe the proposed Lead Researcher as having:

i	Considerable experience of managing *collaborative* projects	**(3)**
ii	A moderate degree of experience of managing *collaborative* projects	**(2)**
iii	A limited amount of experience of managing *collaborative* projects	**(1)**
iv	No previous experience of managing *collaborative* projects	**(0)**

Please write score in box ❑

10. Has the Lead Researcher had any previous experience of *collaborative* projects of similar size (i.e. level of research funding, number of personnel, level of industry involvement) to the proposed project?

Yes = 3
No = 0

Please write score in box ❑

Charting the Results of Section 1

Please add together the *boxed* scores for Questions 1-10. Plot the total score on to the Collaboration Chart under "Lead Researcher".

Section 2 - The Researcher Team

11. By this stage of the project all fields of technical expertise relevant to the project, should have been identified. Does the Researcher Team reflect the needs of the project in terms of relevant expertise?

    Yes = 1
    No = 0

    Please write score in box ❑

12. Is the mix of academic researchers, students and technicians within the Researcher Team appropriate with regard to satisfying the project's skill needs? (*See Guide Notes, Section 5.3.4).*

    Yes = 1
    No = 0

    Please write score in box ❑

13. Have student researchers been assigned to work areas which fulfil the requirements of the degree qualifications for which they are registered? (*See Guide Notes, Section 5.3.4).*

    Yes = 1
    No = 0

    Please write score in box ❑

14. Have any additional training requirements been identified that could improve the effectiveness of the researcher team? If the answer is "Yes", will these needs be met?

    Yes = 1
    No = 0

    Please write score in box ❑

15. Are all members of the researcher team able to meet the time commitments required by the project?

    Yes = 1
    No = 0

Please write score in box ❑

16. Have any gaps been identified within the Researcher Team with regard to the skills, expertise and manpower required to carry out the project?

    If so, has action been taken to resolve the short-fall?

    Yes = 1
    No = 0

Charting the Results of Section 2

Please add together the *boxed* scores for Questions 10-16. Plot the total score on to the Collaboration Chart under "Researcher Team".

Section 3 - Equipment Needs

17. Have the project's equipment needs been identified?

    Yes = 1
    No = 0

    Please write score in box ❑

18. Has the availability of university equipment needed by the project been confirmed?

    Yes = 1
    No = 0

    Please write score in box ❑

19. Have any special arrangements which need to be made regarding such equipment been addressed, e.g. where a skilled operator is needed to operate the equipment?

    Yes = 1
    No = 0

    Please write score in box ❑

20. Have any other constraints been identified with regard to such equipment? If so, have these constraints been taken into account for project planning purposes?

    Yes = 1
    No = 0

    Please write score in box ❑

21. Have any gaps been identified with respect to university's ability to meet the equipment/infrastructural needs of the project?

    If so, has action been taken to resolve the short-fall?

    Yes = 1
    No = 0

Please write score in box ❑

Charting the Results of Section 3

Please add together the *boxed* scores for Questions 17-21. Plot the total score on the Collaboration Chart under "Equipment Needs".

Partner Evaluation Questionnaire

Section 1 - Company Details

1. Please state briefly what your organisation's specific objectives would be with regard to this project.

2. Please indicate the strategic importance of this project to your organisation by circling the appropriate option below:

    i. Very important
    ii. Moderately important
    iii Peripheral interest only

Please provide a brief statement regarding the strategic relevance of the project to your organisation.

3. Please indicate which of the following phrases best describes your organisation's R&D capabilities:

    i. The organisation has an established R&D department which carries out much of the company's research

    ii. The organisation tends to perform much of its development work in-house, but conducts very little research

    iii. The organisation performs very little research or development in-house

Note: *The need for a "research capable" partner will be based on the requirements of the project. Therefore partners required to provide resource support only will generally not be required to be "research capable".*

4. Has your organisation experienced any of the following in the recent past, e.g. in the last 12 months? Please circle the options below as appropriate.

    i. Subject to a merger or a take-over
    ii. Changes to the senior management team
    iii. Significant changes in corporate strategy
    iv. Major re-organisation

Section 2 - Previous Experience of Collaboration

5. Which of the following phrases best describes your organisation's previous experience of collaborative R&D projects:

    i. Considerable experience over a number of years
    ii. Some previous experience of collaborations
    iii. No prior experience of collaborations at all

6. Which of the following phrases best describes your organisation's previous experience of collaborating with universities:

    i. We have traditionally collaborated with universities on research projects
    ii. We have some previous experience of collaborating with universities
    iii. No prior experience of collaborating with universities at all

7. Please provide brief details of the most recent collaborative R&D project in which your organisation has been involved. Please also provide the names of the other partners involved in that project.

❑ *Please tick this box if your organisation has **no objections** to any of the partners listed being contacted.*

Section 3 - The Project Role

8. What would your organisation contribute to the project in terms of expertise, skills and support?

9. Below is a list of ways in which a partner can support a collaborative project. Please indicate which form of support your organisation intends to offer to this project:

    i. *Resource support* - cash contributions, equipment, materials

    ii. *Technical support* - resource support + technical support as required

    iii. *Development support* - resource &/or technical support + an active role in the development work

    iv. *Research support* - resource &/or technical support + an active role in the research work

Important Note: *Options iii. and iv. infer that as a partner, your organisation would be expected to make available appropriately skilled personnel, for an agreed number of man-hours, for active involvement in the research/development activities required by the project.*

Section 4 - Communications

10. Please provide the name of the individual proposed to represent your organisation on the Project Team, and his/her current position within the organisation.

11. We would like to ensure, wherever possible, that the results of the research are disseminated as widely as possible within the partner organisations. Please provide details of any other departments/functions/teams within your organisation who might be interested in the results of the proposed work.

12. Would a member of your organisation's senior management team be willing to participate in the Steering Committee which will preside over the project?

Yes ❑ No ❑

Please provide the name and position of the senior manager likely to represent your organisation on the Steering Committee.

Thank You for your Co-operation

Project Outputs Questionnaire

Section 1 - Respondent Details

Name of Respondent: .....

Respondent's Position within Organisation: .....

Organisation Name: .....

Name of Project of Interest: .....

Section 2 - Project Deliverables

1. Listed below are the project deliverables that this collaborative R&D project is expected to produce. Please indicate in the appropriate box how important each of these deliverables is to your department/organisation's needs.

Project Deliverables	Not Applicable	Relevant	Important	Very Important
1.	0	1	2	3
2.	0	1	2	3
3.	0	1	2	3
4.	0	1	2	3
5.	0	1	2	3
6.	0	1	2	3
7.	0	1	2	3
8.	0	1	2	3
9.	0	1	2	3
10.	0	1	2	3

2. With regard to the listed project deliverables, please indicate in the table below how urgent each of these deliverables are to your department/organisation:

Deliverable Ref. No.	Most Urgent	Average Urgency	Least Urgent
1.	A	B	C
2.	A	B	C
3.	A	B	C
4.	A	B	C
5.	A	B	C
6.	A	B	C
7.	A	B	C
8.	A	B	C
9.	A	B	C
10.	A	B	C

3. If there are any additional project deliverables that you would like to see included, please detail these below:

4. In what form would you prefer to receive general communications regarding project progress?

   I. Brief (two-page) bulletin style progress reports, frequently and regularly produced

   II. Minutes of progress meetings only

   III. Progress reports produced only when there is sufficient progress to report

5. In what form would you prefer to receive disseminated information and research results?

    I. Full research reports produced at an agreed frequency (for example, annually or twice-annually)

    II. A formal presentation, seminar or similar dissemination event to be held at an agreed frequency (for example, annually or twice annually)

6. Do you have any additional suggestions you would like to make regarding the project deliverables?

Section 3 - General Information

This section is to be completed only by parties who are not directly involved in the project or represented on the Project Team. The questions are designed to provide the Project Manager with information regarding other interested parties within the partner organisations, beyond the actual Project Team. This information will help the Project Team to disseminate information more widely within the partner organisations.

7. Please state the main function of your department or team.

8. What constitutes your department/team's main strategy or goal for the future?

9. Please state the nature of your interest in this research project.

This questionnaire is based on the work of M. Hobday & H. Rush regarding User Needs Analysis, reported in Industry & Higher Education, April, 1997, p96-100.

Thank You for your Co-operation

Project Set-up & Execution Questionnaire

Section 1 – The Collaboration Agreement

1. Are all the partners (including the university partners) satisfied with the terms of the collaboration agreement, including arrangements regarding IPR?

   Yes ❑ No ❑

2. Have all the partners signed the collaboration agreement?

   Yes ❑ No ❑

Total number of "Yes" responses for Section 1 ❑

Plot the result on the Collaboration Chart under "collaboration agreement".

Section 2 - Setting Clear Objectives

3. Have the objectives of each of the partners and researchers on the project team been identified and recorded?

   Yes ❑ No ❑

4. Have these objectives been *harmonised* into a clear set of project objectives? (*See Guide Notes, Section 6.2)*

   Yes ❑ No ❑

5. Are all the partners and researchers satisfied with these objectives?

   Yes ❑ No ❑

6. Are the project's objectives and project scope realistic given the resource availability and time constraints on the project?

   Yes ❑ No ❑

Total number of "Yes" responses for Section 2 ❑

Plot the result on the Collaboration Chart under "setting objectives".

Section 3 - Identify Project Deliverables & Timing

7. Have the project deliverables required by the partners and researchers been identified? (The *Project Outputs Questionnaire* (Q-4) can be used to collect this information). *(See Guide notes, Section 6.3)*

   Yes ❑ No ❑

8. Have other interested parties (where identified) within the partner companies also been consulted as to any desired outputs/deliverables?

   Yes ❑ No ❑

9. Have discussions regarding these required deliverables resulted in agreement as to which outputs are feasible/realistic and will therefore be included in the project plan?

   Yes ❑ No ❑

***WARNING** - see Guide notes, Section 6.3*

10. Has a coherent deliverables plan for the project overall been agreed?

    Yes ❑ No ❑

11. Has a timetable been set for the delivery of these deliverables?

    Yes ❑ No ❑

12. Is the timetable realistic given the resources available?

    Yes ❑ No ❑

13. Does the timetable for deliverables include *tangible outcomes* that will be delivered early on in the project and, where possible, at stages throughout the project? *(See Guide Notes, Section 6.3)*

    Yes ❑ No ❑

14. Has agreement been reached on how research results should be disseminated? (The *Project Outputs Questionnaire* (Q-4) can be used to provide this information)

Yes ❑ No ❑

Total number of "Yes" responses for Section 3 ❑

Plot the result on the Collaboration Chart under "deliverables".

Section 4 - The Workplan

15. Has the original workplan (outlined in *Stage 1*) been modified to incorporate the requirements of the partners and researchers? (*See Guide notes, Section 6.4)*

Yes ❑ No ❑

16. Have appropriate timing plans and milestone events been drawn up and agreed for the project (and where applicable for each Work Package)?

Yes ❑ No ❑

17. Have the partners been assigned specific roles and responsibilities within the project/work packages? (*See Guide notes, Section 6.4.1)*

Yes ❑ No ❑

18. Have the researchers similarly been assigned specific roles and responsibilities within the project/work packages? (*See Guide notes, Section 6.4.1)*

Yes ❑ No ❑

19. Are all partners and researchers adequately equipped with the appropriate training/expertise/experience to enable them to carry out their respective roles effectively?

Yes ❑ No ❑

If the response to Question 19 is "No", what action has been taken to provide team members with additional training?

20. Have all the resources required by the project/work packages been assigned, or have arrangements been made for obtaining the required resources?

Yes ❑ No ❑

21. Have any additional constraints or special arrangements associated with equipment or resources been dealt with?

Yes ❑ No ❑

22. Has adequate time been allocated in the project plan for activities such as writing papers, writing reports and student supervision?

Yes ❑ No ❑

23. Has an appropriate level of contingency been included in the project plan to guard against unexpected developments or problems?

Yes ❑ No ❑

24. Having agreed the project plan, are the partners and researchers satisfied that the project, as planned, will be "mutually" beneficial to all concerned? (*See Guide notes, Section 6.4.2)*

Yes ❑ No ❑

25. Are all of the partners and researchers satisfied that the project will provide them with an adequate level of "proprietary" benefit? (*See Guide notes, Section 6.4.2)*

Yes ❑ No ❑

Total number of "Yes" responses for Section 4 ❑

Plot the result on the Collaboration Chart under "workplan".

Section 5 - Effective Communications

26. Has an appropriate representative from each partner been identified for inclusion in the Project Team? (*See Guide notes, Section 6.5.2)*

Yes ❑ No ❑

27. Have the contact details of other interested parties within the partner organisations been collected?

Yes ❑ No ❑

28. Have all appropriate contacts within the University partner(s) been established, including contacts among the support staff and staff working in other relevant research areas?

Yes ❑ No ❑

29. Have these contact details (Question 28) been circulated to all partners?

Yes ❑ No ❑

30. Has a preferred mode of communication, e.g. telephone, fax, e-mail, been established for each member of the Project Team and other interested parties?

Yes ❑ No ❑

31. Has a Steering Committee been set-up to oversee policy and the direction of the project? (*See Guide notes, Section 6.5.1)*

Yes ❑ No ❑

32. Use the table(s) overleaf to determine whether or not the elected Steering Committee Members are appropriate for the role. Each proposed representative must meet all the criteria in order to be deemed acceptable.

Are all those elected to the Steering Committee acceptable?

Yes ❑ No ❑

Total number of "Yes" responses for Section 5 ❑

Plot the result on the Collaboration Chart under "effective communication".

Enter Company name	**1**.....	**2**.....	**3**.....	**4**.. .....
Is the candidate a member of senior management?	❑	❑	❑	❑
Does the candidate have any experience of collaborations?	❑	❑	❑	❑
Does the candidate have any objections to the transfer of technology & information between partner firms (under the terms of the collaboration agreement)?	❑	❑	❑	❑
Is the candidate prepared to champion the project within his/her organisation?	❑	❑	❑	❑
Does the candidate consider collaboration as a valid form of research activity?	❑	❑	❑	❑
Total Number of ✓s per Partner	.....	.....	.....	.....

Enter Company name	**5**.....	**6**.....	**7**.....	**8**.. .....
Is the candidate a member of senior management?	❑	❑	❑	❑
Does the candidate have any experience of collaborations?	❑	❑	❑	❑
Does the candidate have any objections to the transfer of technology & information between partner firms (under the terms of the collaboration agreement)?	❑	❑	❑	❑
Is the candidate prepared to champion the project within his/her organisation?	❑	❑	❑	❑
Does the candidate consider collaboration as a valid form of research activity?	❑	❑	❑	❑
Total Number of ✓s per Partner	.....	.....	.....	.....

Section 6a - Project Monitoring

Project Set-up

33. Has the meeting structure and meeting frequency for the project/work packages been agreed? (*See Guide notes, Section 6.6.1)*

Yes ❑ No ❑

34. Has the meeting structure and meeting frequency for the Steering Committee been agreed?

Yes ❑ No ❑

35. Has the format of the Progress Reports and the reporting frequency been agreed? (*See Guide notes, Section 6.6.2)*

Yes ❑ No ❑

36. Are there Review Procedures in place which will trigger an immediate Project Review should the project a) undergo a significant change in direction, or b) a major problem arise? (*See Guide notes, Section 6.6.3)*

Yes ❑ No ❑

37. Does the project have a coherent strategy with regard to the production of Progress Reports and Internal Research Reports, such that unnecessary levels of bureaucracy will be minimised? (*See Guide notes, Section 6.6.2)*

Yes ❑ No ❑

Total number of "Yes" responses for Section 6a ❑

Plot the result on the Collaboration Chart under "monitoring (project set-up)".

Section 6b - Project Monitoring
Project Execution

38. Are all the partners delivering on the project as required?

Yes ❑ No ❑

39. Are all the researchers delivering on the project as required?

Yes ❑ No ❑

40. Is "mutual" benefit for all partners (including the university researchers) being achieved? (*Outcomes Questionnaire (Q-6) can be used to establish this) See Guide notes, Section 6.4.2*

Yes ❑ No ❑

41. Are all partners realising a satisfactory level of "proprietary" benefit from the project? (*Outcomes Questionnaire (Q-6) can be used to establish this) See Guide notes, Section 6.4.2.*

Yes ❑ No ❑

42. Are the agreed project outputs being achieved to the agreed timescales?

Yes ❑ No ❑

If project outputs are not being achieved as planned or within the timescales agreed, investigate why this is the case through discussion with the Project Team and agree a plan of action.

Total number of "Yes" responses for Section 6b ❑

Plot the result on the Collaboration Chart under "monitoring (project execution)".

Section 7 - Monitor External Influence

38. Does the project have:

    A. A "gate-keeper" assigned to it, or

    B. Have established contacts with key individuals/departments within one or more of the partner organisations who can keep the project briefed as to changes in the external environment?

(See Guide notes, Section 6.7)

Place a tick in the "Yes" box below if the answer to either A or B is "Yes". Otherwise, tick the "No" box.

Yes ❑ No ❑

39. Does the activity of briefing partners on changes in external environmental factors, and discussions regarding the likely implications of such changes for the project, form part of the Steering Committee's brief?

Yes ❑ No ❑

Total number of "Yes" responses for Section 7 ❑

Plot the result on the Collaboration Chart under "external influence".

Section 8 - Post-Project Review

40. Is a Post-Project Review scheduled to take place on completion of the project, in order to capture any learning points arising from the management of the project?

Yes ❑ No ❑

41. Will this Review include a presentation to the Steering Committee, summing-up the achievements of the project, the implications of the results and possible directions for the future?

Yes ❑ No ❑

42. Has a strategy been devised for the final dissemination of the results among all interested parties within the partner organisations? (*See Guide notes, Section 6.6.2)*

Yes ❑ No ❑

Total number of "Yes" responses for Section 8 ❑

Plot the result on the Collaboration Chart under "post-project review".

Outcomes Questionnaire

Name of Respondent:.....

Respondent's Position within Organisation:.....

Organisation Name:.....

Project Title:.....

Date Questionnaire completed:.....

This questionnaire is designed to assess project progress with respect to actual benefits/outcomes accruing to the partners. Please answer the questions as honestly and in as much detail as possible since your responses will aid the Project Manager in managing the collaboration more effectively to the benefit of all parties involved.

1. How closely is the project meeting your organisation's objectives?

I. Very closely
II. Reasonably closely
III. Not closely enough
IV. Not at all

2. On a scale of 1-5, to what extent has your organisation benefited from the current partnership? Where 1=not at all, 5=very significantly.

1 2 3 4 5

3. Please list the benefits realised from the project by your organisation so far (Consider *tangible* outcomes such as IPR and also *intangibles* such as networking or learning).

4. If you feel that your organisation is not satisfactorily benefiting from the project so far, please indicate why you think this is.

5. To what extent do you believe that mutual benefit has been achieved among the partners, i.e. the benefits of the research are equitably distributed among the partners?

   I. Mutual benefit is being achieved

   III. Mutual benefit is not being achieved

Please provide reasons for your answer.

6. Have there been any unexpected benefits or outcomes from the project?

   Yes ❑ No ❑

If so, please briefly describe these benefits/outcomes.

7. Do you believe that your organisation could use some of the learning from this collaboration to bring about innovations internally? *(If so)* What kind of innovations do you foresee?

8. How likely is it that your organisation would consider continuing to collaborate with any or all of the current partners beyond the end of this project?

I. Very likely,
II. Possibly,
III. Not likely,
IV. Never

Please provide reasons for your answers.

9. In your opinion, how successful has this collaborative project been so far?

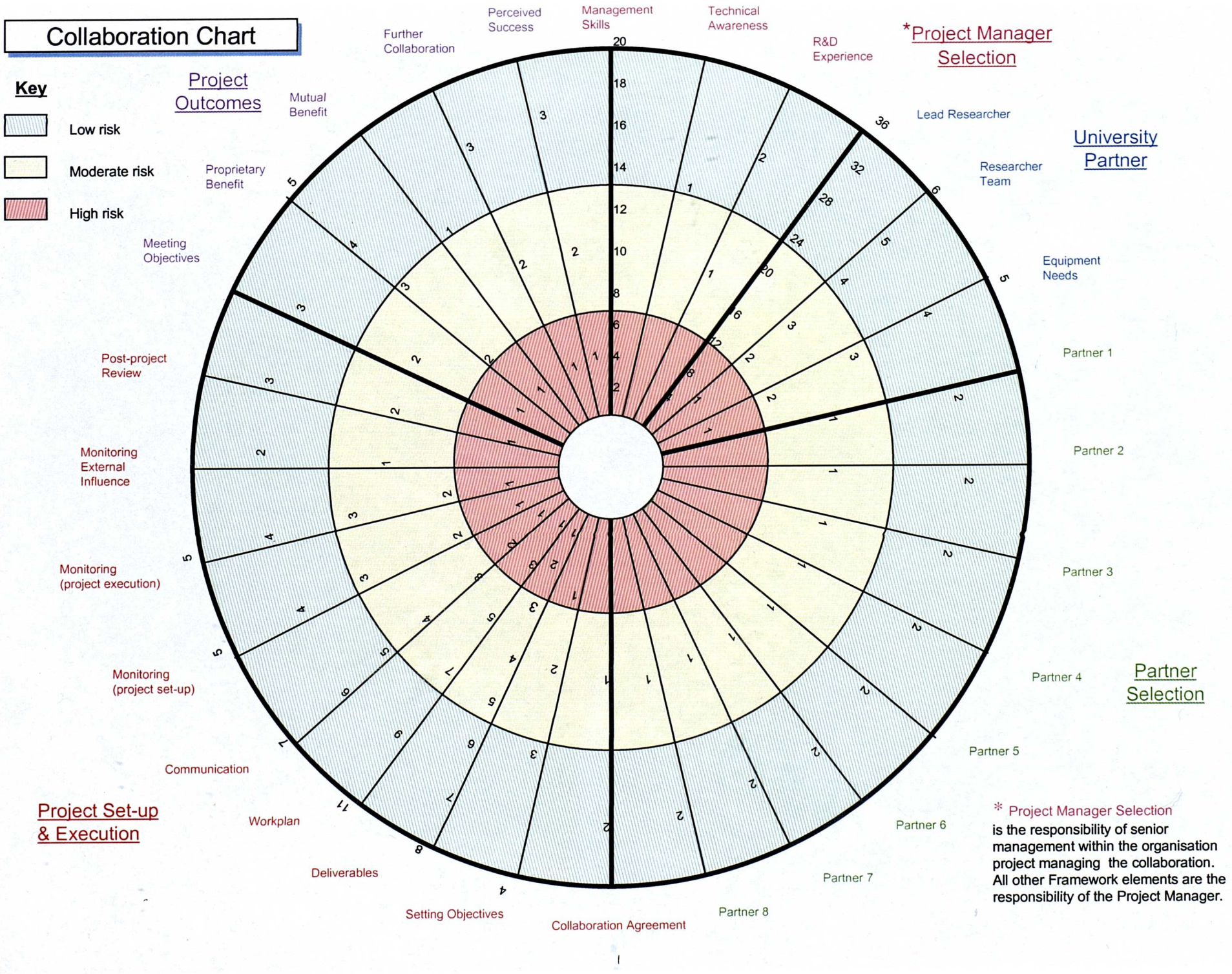
I. Very successful,
II. Moderately successful,
III. Mostly unsuccessful,
IV. Completely unsuccessful.

Please provide reasons for your answer.

10. Have any possible new lines of investigation been identified as a result of the work so far? If so, please describe them briefly below.

11. Do you have any suggestions as to areas of improvement regarding the current set-up of the project or its management? Please detail any suggestions below. The project manager may approach you for further details or clarification at some point in the future.

Thank You for your co-operation


Collaboration Chart
Key
Low risk
Moderate risk
High risk
Project Outcomes
Mutual Benefit
Proprietary Benefit
Meeting Objectives
Further Collaboration
Perceived Success
Management Skills
Technical Awareness
R&D Experience
*Project Manager Selection
Lead Researcher
University Partner
Researcher Team
Equipment Needs
Partner 1
Partner 2
Partner 3
Partner 4
Partner 5
Partner 6
Partner 7
Partner 8
Partner Selection
Post-project Review
Monitoring External Influence
Monitoring (project execution)
Monitoring (project set-up)
Communication
Workplan
Deliverables
Setting Objectives
Collaboration Agreement
Project Set-up & Execution
* Project Manager Selection is the responsibility of senior management within the organisation project managing the collaboration. All other Framework elements are the responsibility of the Project Manager.

Partner Evaluation Chart

Key

Low risk

High risk